Example 3a

June 17, 2020

1 Example 3a: Rotational trap - Training of DeepCalib

Example code to train DeepCallib to determine the stiffness and the rotational component of a Brownian particle system in a non-conservative potential.

DeepCalib 1.0 Enhanced force-field calibration via machine learning version 1.0 - 27 April 2020 l' Aykut Argun, Tobias Thalheim, Stefano Bo, Frank Cichos & Giovanni Volpe Soft Matter Lab

1.1 1. INIZIALIZATION

```
In [1]: import DeepCalib
```

1.2 2. DEFINE TRAJECTORY SIMULATION

Here the function that simulates the motion of the Brownian particle in the force field under consideration is defined. Specifically, in this case, we consider a Brownian particle in a rotational force field, and the motion of the particle depends on the the trap radial component k and the rotational component M.

This file is used to reproduce results that are shown in the numerical section of Fig.5 and generate the pretrained network "Network_Example_3a" that is going to be needed to execute Example 3b.

Comments: 1. The function that simulates the trajectories must be called simulate_trajectory. 2. Lambda functions scale_inputs, rescale_inputs, scale_targets, and rescale_targets must also be defined. For the best performance of the learning, the rescaling of both the inputs and targets should lead to values of order 1.

```
In [11]: ### Physical parameters

         from math import pi

         R = 1e-7                    # Radius of the Brownian particle [m]
         eta = 0.001                 # Viscosity of the medium [kg m^-1 s^-1]
         T = 300                     # Temperature [K]
         k0 = 20                     # Reference stiffness [fN m^-1]
         M0 = 20                     # Reference rotational coefficient [N m^-1]
         gamma0 = 1.3 * 6 * pi * eta * R  # Reference friction coefficient [kg s^-1]

         ### Simulation parameters
```

```
N = 1000                    # Number of samples of the trajectory
Dt = 5e-2                   # Timestep
dt = 5e-3
oversampling = int(Dt/dt)           # Simulation oversampling
t_eq = 10*gamma0/k0
offset = int(t_eq/dt)               # Number of equilibration points

### Define functions to scale and rescale inputs

scale_inputs = lambda x, y: [x * 1e+6, y * 1e+6]     # Scales input trajectory to order
rescale_inputs = lambda scaled_x: [scaled_x * 1e-6,
                                   scaled_y * 1e-6]  # Rescales input trajectory to phy


### Define function to scale and rescale targets

from numpy import log10
from numpy import log
from numpy import exp

scale_targets = lambda k, M: [log(k / k0),
                              M/M0]                          # Scales targets to order 1
rescale_targets = lambda scaled_k, scaled_M: [exp(scaled_k) * k0,
                                              scaled_M*M0] # Inverse of targets_scaling

### Define the simulate_trajectory function

def simulate_trajectory(batch_size=32,
                        T=T,
                        k0=k0,
                        M0=M0,
                        gamma0=gamma0,
                        N=N,
                        Dt=Dt,
                        oversampling=oversampling,
                        offset=offset,
                        scale_inputs=scale_inputs,
                        scale_targets=scale_targets):

    """Simulates a Brownian particle in a rotational trap

    Inputs:

    T:              temperature of the environment
    k0:             center of the radial component range
    M0:             center of the rotational component range
    gamma0:         friction coefficient
```

```
N:              number of trajectory data points
Dt:             measurement period
oversampling:   oversampling from the simulation time step (to calculate dt)
offset:         steps of the simulation before starting to save the trajectory
scale_inputs:   inputs scale function for the network, to normalize it comparable t
scale_targets:  targets scale function for the network, to normalize it comparable

Outputs:

inputs: the inputs for the network, these are trajectories that have the following

        inputs.names:          names of the input trajectory variables ('x', 'y' et
        inputs.values:         values of the inputs in SI units
        inputs.scalings:       short description of the scaling function for the in
        inputs.scaled_values:  scaled values of the inputs to be passed to the netu

targets: the expected ground truth measurements for the trajectory that have follou

        targets.names:          names of the targets to be measures ('k' etc)
        targets.values:         values of the ground truth targets in SI units
        targets.scalings:       short description of the scaling function for the t
        targets.scaled_values:  scaled values of the ground truth targets to be pas
"""

import numpy as np
from scipy.constants import Boltzmann as kB
from math import pi
from math import sqrt
from numpy.random import randn as gauss
from numpy.random import rand as uniform

### Randomize trajectory parameters

k = k0 * 10**(uniform(batch_size)*2 - 1)
M = M0 * (uniform(batch_size)*5 -2.5)
gamma = gamma0 * (uniform(batch_size)*0.2 + .9)

### Simulate

dt = Dt / oversampling
x = np.zeros((batch_size, N))
y = np.zeros((batch_size, N))
D = kB * T / gamma
C1 = -k * 1e-9 / gamma * dt
C2 = -M * 1e-9 / gamma * dt
C3 = np.sqrt(2 * D * dt)

X = x[:,0]
```

```
    Y = y[:,0]
    n = 0

    for t in range(offset):                          # Offset

        X = X + C1 * X - C2 * Y + C3 * gauss(batch_size)
        Y = Y + C1 * Y + C2 * X + C3 * gauss(batch_size)

    for t in range(N * oversampling):                # Simulation
        X = X + C1 * X - C2 * Y + C3 * gauss(batch_size)
        Y = Y + C1 * Y + C2 * X + C3 * gauss(batch_size)
        if t % oversampling == 0:
            x[:,n] = X
            y[:,n] = Y
            n += 1

    # Normalize trajectory and targets

    inputs = DeepCalib.trajectory(
        names=['x', 'y'],
        values=np.swapaxes([x, y],0,1),
        scalings=['x [\u03BCm]', 'y [\u03BCm]'],
        scaled_values=np.swapaxes(scale_inputs(*[x,y]),0,1))

    targets = DeepCalib.targets(
        names=['k [fN/\u03BCm]', 'M [fN/\u03BCm]'],
        values=np.swapaxes([k, M],0,1),
        scalings=['log(k/k0)', 'M/M0'],
        scaled_values=np.swapaxes(scale_targets(*[k, M]),0,1))

    return inputs, targets
```

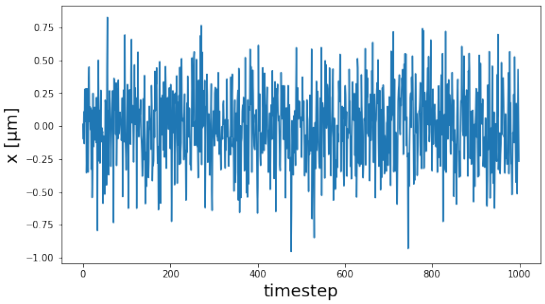
1.3 3. CHECK TRAJECTORY SIMULATION

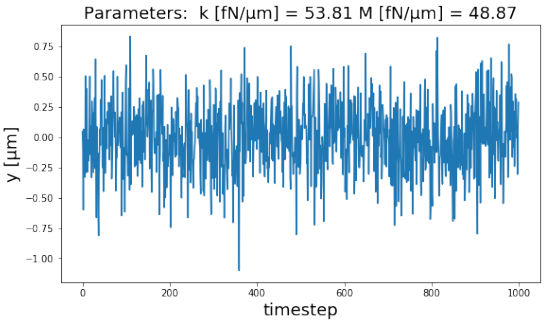
Checks the results of the function to simulate the trajectories by plotting some examples in rescaled units.

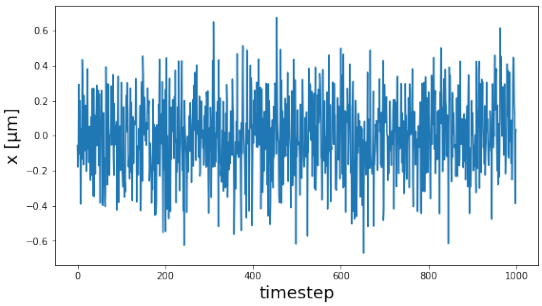
Have a look at the trajectories and check if they match your system, and keep an eye on different trajectories and make sure your scaled units vary in the order of 1, i.e, neither too small (0.01 or smaller) nor too large (100 or larger)

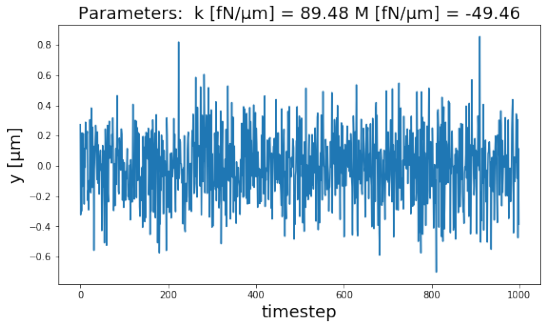
The parameter number_of_images_to_show determines the number of trajectories that are plotted.

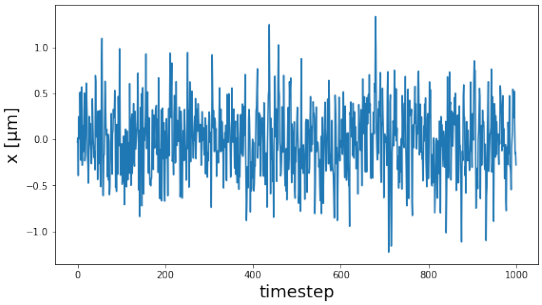
In [12]:
```
### Show some examples of simulated trajectories

number_of_trajectories_to_show = 10

%matplotlib inline
DeepCalib.plot_sample_trajectories(simulate_trajectory, number_of_trajectories_to_show)
```

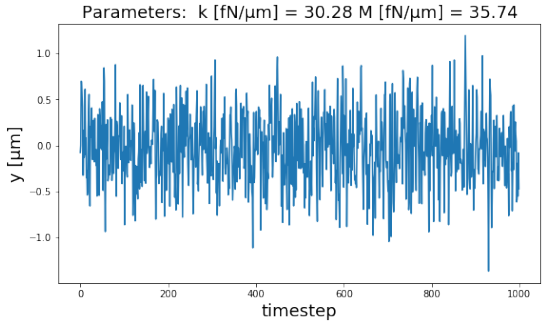

x [μm]
timestep

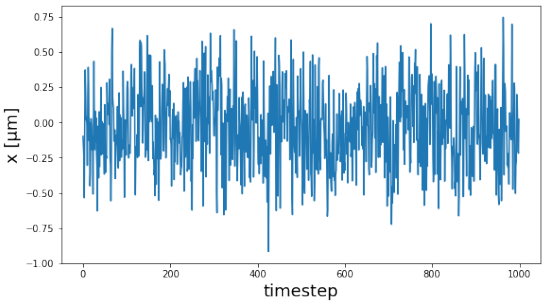

Parameters: k [fN/μm] = 53.81 M [fN/μm] = 48.87
y [μm]
timestep

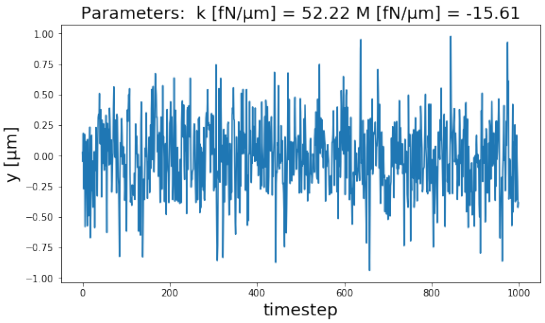

x [μm]
timestep

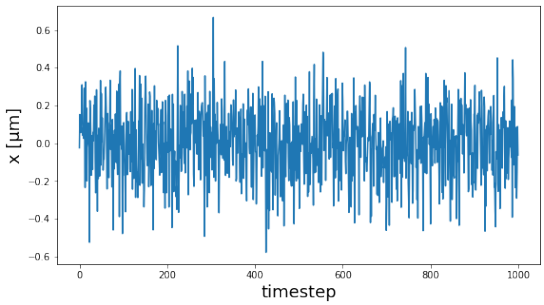

Parameters: k [fN/μm] = 89.48 M [fN/μm] = -49.46
y [μm]
timestep

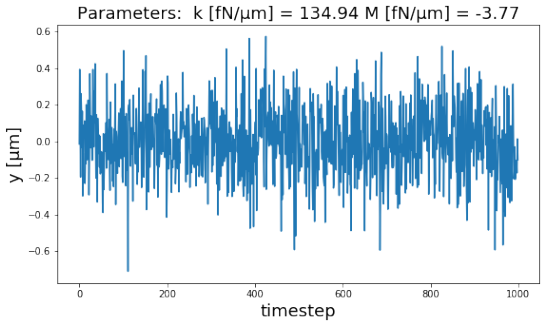

x [μm]
timestep

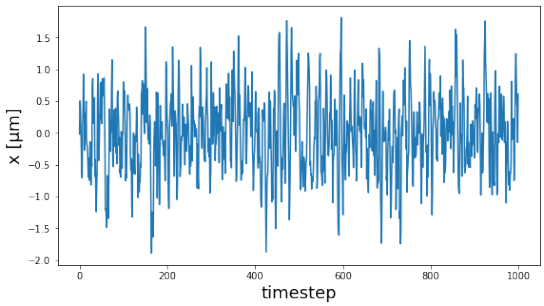

Parameters: k [fN/μm] = 30.28 M [fN/μm] = 35.74
y [μm]
timestep

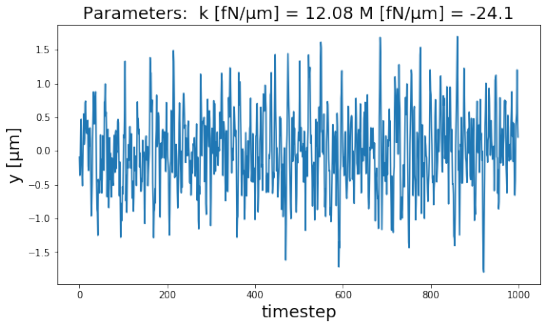

x [μm]
timestep

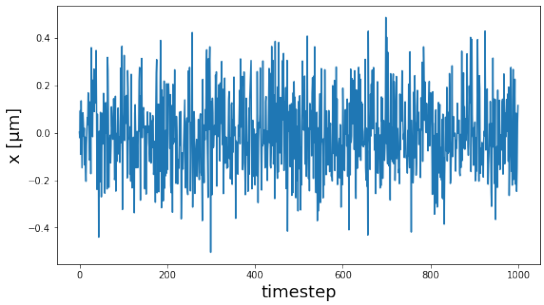

Parameters: k [fN/μm] = 52.22 M [fN/μm] = -15.61
y [μm]
timestep

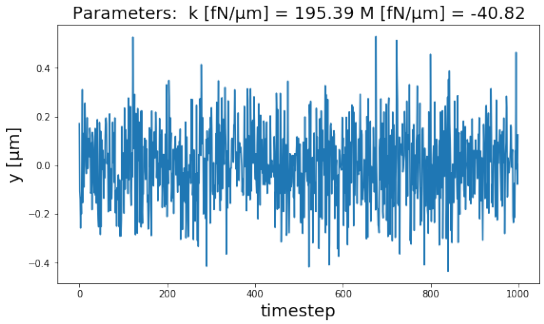

x [µm]
timestep

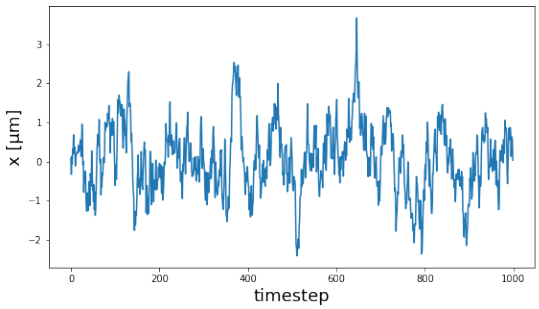

Parameters: k [fN/µm] = 134.94 M [fN/µm] = -3.77
y [µm]
timestep

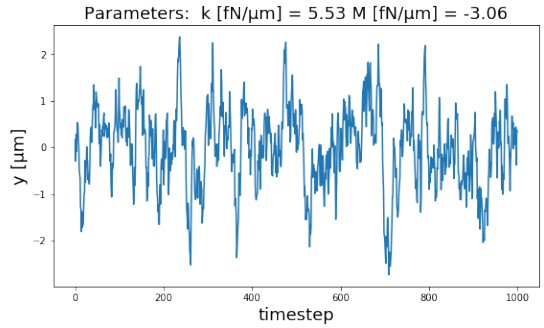

x [µm]
timestep

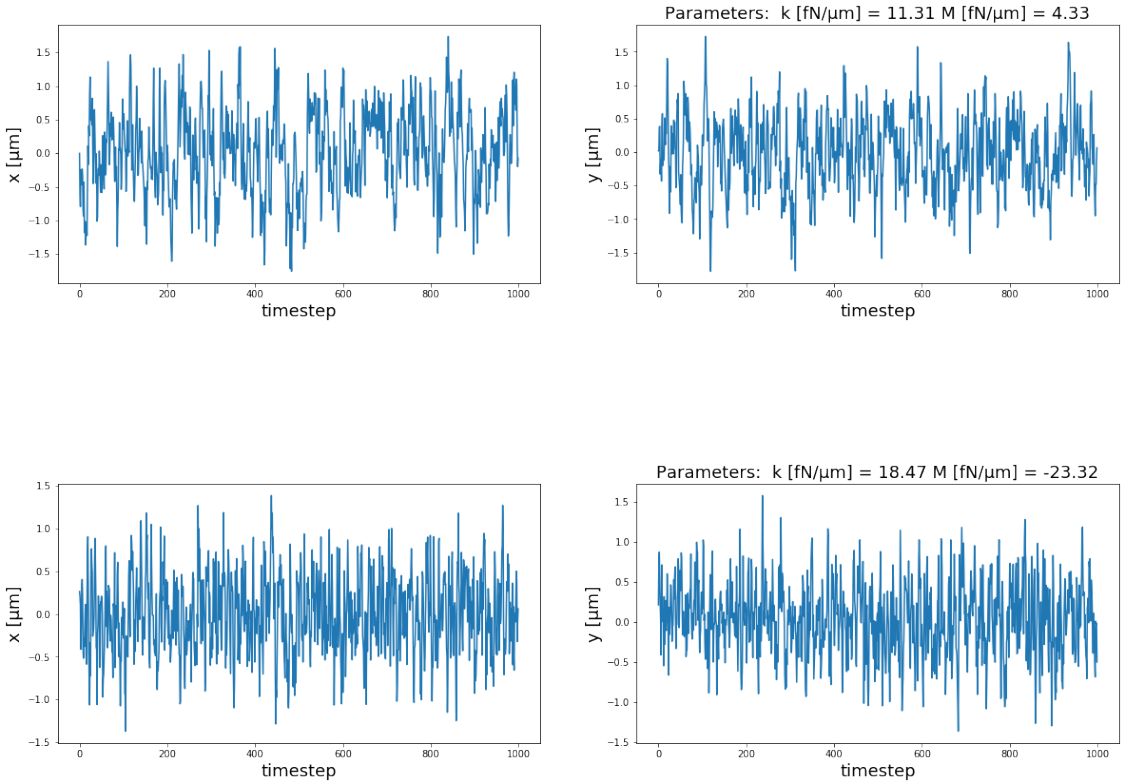

Parameters: k [fN/µm] = 12.08 M [fN/µm] = -24.1
y [µm]
timestep


x [µm]
timestep


Parameters: k [fN/µm] = 195.39 M [fN/µm] = -40.82
y [µm]
timestep


x [µm]
timestep


Parameters: k [fN/µm] = 5.53 M [fN/µm] = -3.06
y [µm]
timestep



1.4 4. CREATE AND COMPILE DEEP LEARNING NETWORK

The parameters of the deep learning network are defined and the network created. The summary of the network is printed where the output shape and number of parameters for each layer can be visualized.

Comments: 1. The parameter input_shape determines the shape of the input sequence, given by the number of time-steps times the number of samples in each input sequence. Make sure your input shape dimensions match the length of the input trajectory, in this example 2 x 1000 = 2000. 2. The parmameter conv_layers_dimensions determines the number and size of LSTM layers. 3. The parameter number_of_outputs determines the number of outputs, i.e. the number of force field parameters to be estimated.

In [6]:
```
### Define parameters of the deep learning network

input_shape = (2, 1000)
lstm_layers_dimensions = (1000, 250, 50)
number_of_outputs = 2

### Create deep learning network
```

```
        network = DeepCalib.create_deep_learning_network(input_shape, lstm_layers_dimensions, nu

        ### Print deep learning network summary

        network.summary()
```

```
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 2, 1000)           8004000
_________________________________________________________________
lstm_2 (LSTM)                (None, 2, 250)            1251000
_________________________________________________________________
lstm_3 (LSTM)                (None, 50)                60200
_________________________________________________________________
output (Dense)               (None, 2)                 102
=================================================================
Total params: 9,315,302
Trainable params: 9,315,302
Non-trainable params: 0
_________________________________________________________________
```

1.5 5. TRAIN DEEP LEARNING NETWORK

The parameters for the training of the deep learning network are defined and the network is trained. The sample size, iteration number, MSE, MAE and the time of each iteration is printed.

Comments: 1. The parameter sample_sizes determines the sizes of the batches of trajectories used in the training. 2. The parameter iteration_numbers determines the numbers of batches used in the training. 3. The parameter verbose determines the frequency of the update messages. It can be either a boolean value (True/False) or a number between 0 and 1.

In [7]:
```
        ### Define parameters of the training

        sample_sizes = (32, 128, 512, 2048, 4096)
        iteration_numbers = (1001, 1001, 3001, 3001, 4001)
        verbose = .1

        ### Training
        training_history = DeepCalib.train_deep_learning_network(network, simulate_trajectory, s
```

```
Sample size     32   iteration number      1   MSE     2.0823   MAE     1.2505   Time 5093.00017
Sample size     32   iteration number     11   MSE     2.2608   MAE     1.2924   Time 109.430075
Sample size     32   iteration number     21   MSE     1.8955   MAE     1.1855   Time 113.164186
Sample size     32   iteration number     31   MSE     1.7062   MAE     1.1150   Time 113.186598
Sample size     32   iteration number     41   MSE     1.5079   MAE     1.0190   Time 108.441114
Sample size     32   iteration number     51   MSE     1.6076   MAE     1.0865   Time 108.117104
Sample size     32   iteration number     61   MSE     1.3837   MAE     0.9438   Time 109.647036
Sample size     32   iteration number     71   MSE     1.2544   MAE     0.9123   Time 110.501051
```

```
Sample size     32   iteration number     81   MSE     1.2242   MAE     0.8445   Time 112.050295
Sample size     32   iteration number     91   MSE     0.7453   MAE     0.6822   Time 110.431433
Sample size     32   iteration number    101   MSE     1.1339   MAE     0.7932   Time 111.159325
Sample size     32   iteration number    111   MSE     1.0351   MAE     0.7850   Time 109.336853
Sample size     32   iteration number    121   MSE     1.2324   MAE     0.8413   Time 111.199379
Sample size     32   iteration number    131   MSE     1.1117   MAE     0.8076   Time 110.353231
Sample size     32   iteration number    141   MSE     1.3232   MAE     0.8594   Time 108.442307
Sample size     32   iteration number    151   MSE     0.9193   MAE     0.7368   Time 109.536886
Sample size     32   iteration number    161   MSE     1.1821   MAE     0.8324   Time 109.463215
Sample size     32   iteration number    171   MSE     0.8706   MAE     0.6888   Time 107.024193
Sample size     32   iteration number    181   MSE     1.0628   MAE     0.7566   Time 108.901978
Sample size     32   iteration number    191   MSE     0.6025   MAE     0.5974   Time 109.066963
Sample size     32   iteration number    201   MSE     0.7528   MAE     0.6218   Time  97.379446
Sample size     32   iteration number    211   MSE     0.7012   MAE     0.6413   Time 109.958887
Sample size     32   iteration number    221   MSE     0.7847   MAE     0.5981   Time 108.029366
Sample size     32   iteration number    231   MSE     0.6863   MAE     0.6069   Time 112.372160
Sample size     32   iteration number    241   MSE     0.6883   MAE     0.5985   Time 110.356331
Sample size     32   iteration number    251   MSE     0.7132   MAE     0.5705   Time 112.669706
Sample size     32   iteration number    261   MSE     0.7760   MAE     0.6425   Time 108.476162
Sample size     32   iteration number    271   MSE     0.7511   MAE     0.5648   Time 110.364199
Sample size     32   iteration number    281   MSE     0.7189   MAE     0.6319   Time 107.038498
Sample size     32   iteration number    291   MSE     0.8014   MAE     0.6154   Time 110.841513
Sample size     32   iteration number    301   MSE     0.7648   MAE     0.5824   Time 109.820366
Sample size     32   iteration number    311   MSE     0.7431   MAE     0.5801   Time 108.709097
Sample size     32   iteration number    321   MSE     0.4863   MAE     0.4694   Time 107.717752
Sample size     32   iteration number    331   MSE     0.6307   MAE     0.6004   Time 108.950853
Sample size     32   iteration number    341   MSE     0.6351   MAE     0.5313   Time 110.881567
Sample size     32   iteration number    351   MSE     0.5875   MAE     0.4968   Time 109.146833
Sample size     32   iteration number    361   MSE     0.5940   MAE     0.4961   Time 115.619421
Sample size     32   iteration number    371   MSE     0.4929   MAE     0.4928   Time 107.975483
Sample size     32   iteration number    381   MSE     0.7984   MAE     0.5918   Time 110.865355
Sample size     32   iteration number    391   MSE     0.7576   MAE     0.6146   Time 108.167410
Sample size     32   iteration number    401   MSE     0.7011   MAE     0.5263   Time 108.164549
Sample size     32   iteration number    411   MSE     0.6811   MAE     0.5343   Time 108.111620
Sample size     32   iteration number    421   MSE     0.3778   MAE     0.4199   Time 107.029438
Sample size     32   iteration number    431   MSE     0.5557   MAE     0.4863   Time 108.822107
Sample size     32   iteration number    441   MSE     0.2993   MAE     0.3647   Time 111.799240
Sample size     32   iteration number    451   MSE     0.6230   MAE     0.5471   Time 109.548569
Sample size     32   iteration number    461   MSE     0.7010   MAE     0.4968   Time 109.452963
Sample size     32   iteration number    471   MSE     0.2097   MAE     0.3185   Time 108.657837
Sample size     32   iteration number    481   MSE     0.5287   MAE     0.4908   Time 113.701344
Sample size     32   iteration number    491   MSE     0.6455   MAE     0.5094   Time 118.415833
Sample size     32   iteration number    501   MSE     0.6625   MAE     0.5462   Time 109.909296
Sample size     32   iteration number    511   MSE     0.3771   MAE     0.4026   Time 109.734774
Sample size     32   iteration number    521   MSE     0.4814   MAE     0.4686   Time 111.289263
Sample size     32   iteration number    531   MSE     0.7651   MAE     0.5996   Time 113.332272
Sample size     32   iteration number    541   MSE     0.5386   MAE     0.4627   Time 110.614777
Sample size     32   iteration number    551   MSE     0.4991   MAE     0.4445   Time 107.243538
```

```
Sample size     32   iteration number    561   MSE     0.4005   MAE     0.3857   Time 110.391617
Sample size     32   iteration number    571   MSE     0.4680   MAE     0.4448   Time 110.589504
Sample size     32   iteration number    581   MSE     0.4758   MAE     0.4325   Time 107.997894
Sample size     32   iteration number    591   MSE     0.6368   MAE     0.5343   Time 108.577967
Sample size     32   iteration number    601   MSE     0.7325   MAE     0.5411   Time 108.775377
Sample size     32   iteration number    611   MSE     0.4176   MAE     0.4052   Time 111.328363
Sample size     32   iteration number    621   MSE     0.4679   MAE     0.4263   Time 108.817339
Sample size     32   iteration number    631   MSE     0.4116   MAE     0.4509   Time 127.061367
Sample size     32   iteration number    641   MSE     0.2769   MAE     0.3172   Time 118.459702
Sample size     32   iteration number    651   MSE     0.6734   MAE     0.4875   Time 107.133865
Sample size     32   iteration number    661   MSE     0.4184   MAE     0.3819   Time 109.117031
Sample size     32   iteration number    671   MSE     0.6115   MAE     0.5041   Time 128.877401
Sample size     32   iteration number    681   MSE     0.4580   MAE     0.4576   Time 129.544735
Sample size     32   iteration number    691   MSE     0.3688   MAE     0.3753   Time 116.940975
Sample size     32   iteration number    701   MSE     0.3447   MAE     0.3888   Time 109.816074
Sample size     32   iteration number    711   MSE     0.3785   MAE     0.4070   Time 119.482756
Sample size     32   iteration number    721   MSE     0.5135   MAE     0.4486   Time 108.738422
Sample size     32   iteration number    731   MSE     0.8023   MAE     0.5717   Time 109.160900
Sample size     32   iteration number    741   MSE     0.4549   MAE     0.4175   Time  96.344709
Sample size     32   iteration number    751   MSE     0.5224   MAE     0.4579   Time 109.451532
Sample size     32   iteration number    761   MSE     0.5802   MAE     0.4801   Time 108.371973
Sample size     32   iteration number    771   MSE     0.6327   MAE     0.4829   Time 107.323647
Sample size     32   iteration number    781   MSE     0.5777   MAE     0.4619   Time 110.285282
Sample size     32   iteration number    791   MSE     0.5202   MAE     0.4152   Time 111.990690
Sample size     32   iteration number    801   MSE     0.3434   MAE     0.3840   Time 110.152960
Sample size     32   iteration number    811   MSE     0.5688   MAE     0.4785   Time 112.170458
Sample size     32   iteration number    821   MSE     0.7520   MAE     0.5404   Time 113.027573
Sample size     32   iteration number    831   MSE     0.4925   MAE     0.4270   Time 116.530895
Sample size     32   iteration number    841   MSE     0.2779   MAE     0.3154   Time 114.154816
Sample size     32   iteration number    851   MSE     0.4882   MAE     0.4329   Time 108.955145
Sample size     32   iteration number    861   MSE     0.3731   MAE     0.3927   Time 111.850977
Sample size     32   iteration number    871   MSE     0.4192   MAE     0.4222   Time 108.568192
Sample size     32   iteration number    881   MSE     0.2489   MAE     0.3046   Time 109.184742
Sample size     32   iteration number    891   MSE     0.5419   MAE     0.4387   Time 108.220577
Sample size     32   iteration number    901   MSE     0.3456   MAE     0.3596   Time 106.255531
Sample size     32   iteration number    911   MSE     0.5912   MAE     0.4746   Time 109.645128
Sample size     32   iteration number    921   MSE     0.6305   MAE     0.5142   Time 110.604763
Sample size     32   iteration number    931   MSE     0.4134   MAE     0.3902   Time 104.937315
Sample size     32   iteration number    941   MSE     0.3779   MAE     0.3896   Time 111.066103
Sample size     32   iteration number    951   MSE     0.5202   MAE     0.4427   Time 108.533382
Sample size     32   iteration number    961   MSE     0.5732   MAE     0.4849   Time 118.483543
Sample size     32   iteration number    971   MSE     0.4951   MAE     0.4427   Time 107.801914
Sample size     32   iteration number    981   MSE     0.3333   MAE     0.3666   Time 112.098455
Sample size     32   iteration number    991   MSE     0.3707   MAE     0.3980   Time 109.348059
Sample size     32   iteration number   1001   MSE     0.5347   MAE     0.4024   Time 109.840631
Sample size    128   iteration number      1   MSE     0.3217   MAE     0.3419   Time 175.540686
Sample size    128   iteration number     11   MSE     0.3424   MAE     0.3449   Time 175.070286
Sample size    128   iteration number     21   MSE     0.4296   MAE     0.4025   Time 177.340508
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Sample size    128   iteration number     31   MSE     0.3427   MAE     0.3523   Time 176.943541
Sample size    128   iteration number     41   MSE     0.3148   MAE     0.3291   Time 176.404238
Sample size    128   iteration number     51   MSE     0.3407   MAE     0.3503   Time 176.249027
Sample size    128   iteration number     61   MSE     0.4417   MAE     0.3897   Time 174.425602
Sample size    128   iteration number     71   MSE     0.3061   MAE     0.3058   Time 176.941156
Sample size    128   iteration number     81   MSE     0.4094   MAE     0.3625   Time 179.531336
Sample size    128   iteration number     91   MSE     0.3038   MAE     0.3065   Time 172.958374
Sample size    128   iteration number    101   MSE     0.3871   MAE     0.3464   Time 176.885605
Sample size    128   iteration number    111   MSE     0.3792   MAE     0.3345   Time 176.435232
Sample size    128   iteration number    121   MSE     0.3641   MAE     0.3335   Time 175.040245
Sample size    128   iteration number    131   MSE     0.3416   MAE     0.3320   Time 175.730944
Sample size    128   iteration number    141   MSE     0.2973   MAE     0.3057   Time 176.508904
Sample size    128   iteration number    151   MSE     0.4184   MAE     0.3399   Time 180.946350
Sample size    128   iteration number    161   MSE     0.4250   MAE     0.3690   Time 176.259518
Sample size    128   iteration number    171   MSE     0.3213   MAE     0.3264   Time 178.122044
Sample size    128   iteration number    181   MSE     0.3711   MAE     0.3369   Time 174.527884
Sample size    128   iteration number    191   MSE     0.3914   MAE     0.3471   Time 175.882339
Sample size    128   iteration number    201   MSE     0.3227   MAE     0.3052   Time 174.526691
Sample size    128   iteration number    211   MSE     0.3055   MAE     0.3025   Time 173.296928
Sample size    128   iteration number    221   MSE     0.4242   MAE     0.3566   Time 175.421000
Sample size    128   iteration number    231   MSE     0.5249   MAE     0.3868   Time 179.603577
Sample size    128   iteration number    241   MSE     0.2571   MAE     0.2974   Time 174.556494
Sample size    128   iteration number    251   MSE     0.3778   MAE     0.3250   Time 175.744295
Sample size    128   iteration number    261   MSE     0.2945   MAE     0.3119   Time 176.321030
Sample size    128   iteration number    271   MSE     0.2416   MAE     0.2865   Time 173.804045
Sample size    128   iteration number    281   MSE     0.3609   MAE     0.3543   Time 175.603628
Sample size    128   iteration number    291   MSE     0.2980   MAE     0.2862   Time 179.498196
Sample size    128   iteration number    301   MSE     0.3215   MAE     0.3205   Time 174.685240
Sample size    128   iteration number    311   MSE     0.3465   MAE     0.3059   Time 175.321579
Sample size    128   iteration number    321   MSE     0.3061   MAE     0.3026   Time 178.647995
Sample size    128   iteration number    331   MSE     0.3149   MAE     0.3068   Time 180.037260
Sample size    128   iteration number    341   MSE     0.3110   MAE     0.3048   Time 176.754951
Sample size    128   iteration number    351   MSE     0.3772   MAE     0.3475   Time 176.124811
Sample size    128   iteration number    361   MSE     0.3248   MAE     0.3134   Time 175.770998
Sample size    128   iteration number    371   MSE     0.2102   MAE     0.2498   Time 165.879965
Sample size    128   iteration number    381   MSE     0.3061   MAE     0.3092   Time 182.689428
Sample size    128   iteration number    391   MSE     0.2854   MAE     0.3116   Time 174.002409
Sample size    128   iteration number    401   MSE     0.3434   MAE     0.3141   Time 176.053286
Sample size    128   iteration number    411   MSE     0.2491   MAE     0.2743   Time 176.051617
Sample size    128   iteration number    421   MSE     0.2935   MAE     0.2951   Time 169.235468
Sample size    128   iteration number    431   MSE     0.3146   MAE     0.2951   Time 175.946474
Sample size    128   iteration number    441   MSE     0.2090   MAE     0.2553   Time 178.683996
Sample size    128   iteration number    451   MSE     0.2739   MAE     0.2834   Time 173.534632
Sample size    128   iteration number    461   MSE     0.2785   MAE     0.2834   Time 181.765318
Sample size    128   iteration number    471   MSE     0.2432   MAE     0.2724   Time 170.919418
Sample size    128   iteration number    481   MSE     0.3321   MAE     0.3145   Time 179.305792
Sample size    128   iteration number    491   MSE     0.2371   MAE     0.2748   Time 172.939777
Sample size    128   iteration number    501   MSE     0.1856   MAE     0.2350   Time 172.793627
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Sample size    128   iteration number    511   MSE     0.2847   MAE     0.2846   Time 180.543661
Sample size    128   iteration number    521   MSE     0.2960   MAE     0.2876   Time 175.881863
Sample size    128   iteration number    531   MSE     0.2121   MAE     0.2548   Time 174.471140
Sample size    128   iteration number    541   MSE     0.2847   MAE     0.2881   Time 174.431562
Sample size    128   iteration number    551   MSE     0.2740   MAE     0.3023   Time 179.536819
Sample size    128   iteration number    561   MSE     0.3320   MAE     0.3097   Time 175.713539
Sample size    128   iteration number    571   MSE     0.2895   MAE     0.2903   Time 171.151638
Sample size    128   iteration number    581   MSE     0.3247   MAE     0.2964   Time 177.492857
Sample size    128   iteration number    591   MSE     0.2689   MAE     0.3018   Time 178.987980
Sample size    128   iteration number    601   MSE     0.3484   MAE     0.3310   Time 186.440945
Sample size    128   iteration number    611   MSE     0.3244   MAE     0.3034   Time 176.569223
Sample size    128   iteration number    621   MSE     0.2260   MAE     0.2476   Time 181.682348
Sample size    128   iteration number    631   MSE     0.2607   MAE     0.2726   Time 174.374580
Sample size    128   iteration number    641   MSE     0.3466   MAE     0.3445   Time 173.374414
Sample size    128   iteration number    651   MSE     0.3247   MAE     0.3046   Time 177.472591
Sample size    128   iteration number    661   MSE     0.2680   MAE     0.2750   Time 178.392410
Sample size    128   iteration number    671   MSE     0.2627   MAE     0.2868   Time 174.498320
Sample size    128   iteration number    681   MSE     0.2263   MAE     0.2821   Time 173.217297
Sample size    128   iteration number    691   MSE     0.2296   MAE     0.2632   Time 174.723864
Sample size    128   iteration number    701   MSE     0.3216   MAE     0.3119   Time 174.172163
Sample size    128   iteration number    711   MSE     0.2665   MAE     0.2740   Time 176.882505
Sample size    128   iteration number    721   MSE     0.3873   MAE     0.3267   Time 176.260233
Sample size    128   iteration number    731   MSE     0.2630   MAE     0.2761   Time 178.095579
Sample size    128   iteration number    741   MSE     0.2043   MAE     0.2559   Time 175.941229
Sample size    128   iteration number    751   MSE     0.2553   MAE     0.2684   Time 174.881697
Sample size    128   iteration number    761   MSE     0.2327   MAE     0.2590   Time 172.709942
Sample size    128   iteration number    771   MSE     0.3215   MAE     0.2965   Time 172.956467
Sample size    128   iteration number    781   MSE     0.2256   MAE     0.2698   Time 170.957565
Sample size    128   iteration number    791   MSE     0.2144   MAE     0.2556   Time 176.872253
Sample size    128   iteration number    801   MSE     0.1841   MAE     0.2461   Time 173.849344
Sample size    128   iteration number    811   MSE     0.2722   MAE     0.2788   Time 176.159620
Sample size    128   iteration number    821   MSE     0.2825   MAE     0.2831   Time 173.917294
Sample size    128   iteration number    831   MSE     0.2981   MAE     0.2826   Time 176.764727
Sample size    128   iteration number    841   MSE     0.3123   MAE     0.2881   Time 178.423405
Sample size    128   iteration number    851   MSE     0.2955   MAE     0.2867   Time 175.048828
Sample size    128   iteration number    861   MSE     0.3040   MAE     0.3139   Time 173.397779
Sample size    128   iteration number    871   MSE     0.2547   MAE     0.2835   Time 172.772408
Sample size    128   iteration number    881   MSE     0.2654   MAE     0.3021   Time 173.578978
Sample size    128   iteration number    891   MSE     0.3105   MAE     0.3107   Time 173.860312
Sample size    128   iteration number    901   MSE     0.3029   MAE     0.2915   Time 173.907757
Sample size    128   iteration number    911   MSE     0.2561   MAE     0.2568   Time 173.871040
Sample size    128   iteration number    921   MSE     0.2979   MAE     0.2987   Time 175.716400
Sample size    128   iteration number    931   MSE     0.3160   MAE     0.2859   Time 174.141645
Sample size    128   iteration number    941   MSE     0.2843   MAE     0.2849   Time 174.171448
Sample size    128   iteration number    951   MSE     0.3446   MAE     0.3010   Time 175.877333
Sample size    128   iteration number    961   MSE     0.2319   MAE     0.2780   Time 176.693678
Sample size    128   iteration number    971   MSE     0.3478   MAE     0.3171   Time 173.268795
Sample size    128   iteration number    981   MSE     0.2183   MAE     0.2436   Time 173.400164
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Sample size    128   iteration number    991   MSE     0.2094   MAE     0.2416   Time 176.143408
Sample size    128   iteration number   1001   MSE     0.2442   MAE     0.2591   Time 179.539680
Sample size    512   iteration number      1   MSE     0.2671   MAE     0.2829   Time 424.290180
Sample size    512   iteration number     11   MSE     0.2372   MAE     0.2616   Time 411.635876
Sample size    512   iteration number     21   MSE     0.2504   MAE     0.2679   Time 397.387028
Sample size    512   iteration number     31   MSE     0.2439   MAE     0.2624   Time 413.246155
Sample size    512   iteration number     41   MSE     0.1984   MAE     0.2299   Time 397.062063
Sample size    512   iteration number     51   MSE     0.2607   MAE     0.2687   Time 410.769939
Sample size    512   iteration number     61   MSE     0.2285   MAE     0.2556   Time 426.662207
Sample size    512   iteration number     71   MSE     0.2351   MAE     0.2435   Time 410.075903
Sample size    512   iteration number     81   MSE     0.2580   MAE     0.2593   Time 410.379410
Sample size    512   iteration number     91   MSE     0.2736   MAE     0.2646   Time 423.470974
Sample size    512   iteration number    101   MSE     0.2140   MAE     0.2384   Time 408.632278
Sample size    512   iteration number    111   MSE     0.2508   MAE     0.2547   Time 415.613890
Sample size    512   iteration number    121   MSE     0.2381   MAE     0.2498   Time 425.319433
Sample size    512   iteration number    131   MSE     0.2317   MAE     0.2475   Time 411.536694
Sample size    512   iteration number    141   MSE     0.2022   MAE     0.2360   Time 409.836769
Sample size    512   iteration number    151   MSE     0.1999   MAE     0.2319   Time 395.237684
Sample size    512   iteration number    161   MSE     0.2165   MAE     0.2430   Time 409.326077
Sample size    512   iteration number    171   MSE     0.2407   MAE     0.2449   Time 410.286665
Sample size    512   iteration number    181   MSE     0.2289   MAE     0.2493   Time 410.664320
Sample size    512   iteration number    191   MSE     0.2271   MAE     0.2383   Time 408.520937
Sample size    512   iteration number    201   MSE     0.2232   MAE     0.2407   Time 412.134171
Sample size    512   iteration number    211   MSE     0.2165   MAE     0.2318   Time 409.091473
Sample size    512   iteration number    221   MSE     0.2090   MAE     0.2421   Time 410.626173
Sample size    512   iteration number    231   MSE     0.2239   MAE     0.2437   Time 413.340569
Sample size    512   iteration number    241   MSE     0.2148   MAE     0.2402   Time 410.101652
Sample size    512   iteration number    251   MSE     0.2577   MAE     0.2590   Time 397.598743
Sample size    512   iteration number    261   MSE     0.2143   MAE     0.2399   Time 418.973207
Sample size    512   iteration number    271   MSE     0.2373   MAE     0.2415   Time 426.392317
Sample size    512   iteration number    281   MSE     0.2172   MAE     0.2343   Time 409.693480
Sample size    512   iteration number    291   MSE     0.2270   MAE     0.2392   Time 409.921169
Sample size    512   iteration number    301   MSE     0.2170   MAE     0.2343   Time 408.766031
Sample size    512   iteration number    311   MSE     0.2663   MAE     0.2563   Time 408.703327
Sample size    512   iteration number    321   MSE     0.2417   MAE     0.2499   Time 418.261528
Sample size    512   iteration number    331   MSE     0.2426   MAE     0.2518   Time 395.271301
Sample size    512   iteration number    341   MSE     0.2128   MAE     0.2341   Time 413.954258
Sample size    512   iteration number    351   MSE     0.2579   MAE     0.2457   Time 409.428358
Sample size    512   iteration number    361   MSE     0.2015   MAE     0.2264   Time 420.847893
Sample size    512   iteration number    371   MSE     0.2049   MAE     0.2291   Time 412.372351
Sample size    512   iteration number    381   MSE     0.1568   MAE     0.2015   Time 410.159826
Sample size    512   iteration number    391   MSE     0.2261   MAE     0.2360   Time 410.941362
Sample size    512   iteration number    401   MSE     0.2413   MAE     0.2424   Time 425.848484
Sample size    512   iteration number    411   MSE     0.1887   MAE     0.2261   Time 408.624887
Sample size    512   iteration number    421   MSE     0.2444   MAE     0.2396   Time 408.926010
Sample size    512   iteration number    431   MSE     0.2184   MAE     0.2321   Time 423.960209
Sample size    512   iteration number    441   MSE     0.2558   MAE     0.2574   Time 413.565636
Sample size    512   iteration number    451   MSE     0.2046   MAE     0.2349   Time 423.625946
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Sample size    512   iteration number    461   MSE     0.2319   MAE     0.2365   Time 409.314632
Sample size    512   iteration number    471   MSE     0.2678   MAE     0.2611   Time 409.840107
Sample size    512   iteration number    481   MSE     0.1783   MAE     0.2143   Time 397.422552
Sample size    512   iteration number    491   MSE     0.2056   MAE     0.2251   Time 423.063040
Sample size    512   iteration number    501   MSE     0.2391   MAE     0.2504   Time 410.950899
Sample size    512   iteration number    511   MSE     0.2052   MAE     0.2316   Time 409.921885
Sample size    512   iteration number    521   MSE     0.1614   MAE     0.2108   Time 425.201893
Sample size    512   iteration number    531   MSE     0.1926   MAE     0.2226   Time 410.829544
Sample size    512   iteration number    541   MSE     0.2401   MAE     0.2555   Time 411.873817
Sample size    512   iteration number    551   MSE     0.2007   MAE     0.2357   Time 409.079790
Sample size    512   iteration number    561   MSE     0.2168   MAE     0.2368   Time 428.111315
Sample size    512   iteration number    571   MSE     0.2410   MAE     0.2372   Time 409.685373
Sample size    512   iteration number    581   MSE     0.2531   MAE     0.2532   Time 408.402681
Sample size    512   iteration number    591   MSE     0.2092   MAE     0.2394   Time 425.694704
Sample size    512   iteration number    601   MSE     0.2093   MAE     0.2307   Time 409.539938
Sample size    512   iteration number    611   MSE     0.2618   MAE     0.2616   Time 412.069321
Sample size    512   iteration number    621   MSE     0.2073   MAE     0.2293   Time 410.523891
Sample size    512   iteration number    631   MSE     0.2028   MAE     0.2254   Time 408.314705
Sample size    512   iteration number    641   MSE     0.2000   MAE     0.2216   Time 407.228708
Sample size    512   iteration number    651   MSE     0.2200   MAE     0.2371   Time 409.609556
Sample size    512   iteration number    661   MSE     0.1882   MAE     0.2283   Time 423.065662
Sample size    512   iteration number    671   MSE     0.2181   MAE     0.2290   Time 412.258148
Sample size    512   iteration number    681   MSE     0.1940   MAE     0.2123   Time 410.766363
Sample size    512   iteration number    691   MSE     0.2551   MAE     0.2514   Time 407.685518
Sample size    512   iteration number    701   MSE     0.1948   MAE     0.2238   Time 411.933184
Sample size    512   iteration number    711   MSE     0.1964   MAE     0.2156   Time 395.717859
Sample size    512   iteration number    721   MSE     0.2213   MAE     0.2320   Time 426.667452
Sample size    512   iteration number    731   MSE     0.2480   MAE     0.2488   Time 409.860849
Sample size    512   iteration number    741   MSE     0.2138   MAE     0.2339   Time 412.326097
Sample size    512   iteration number    751   MSE     0.2267   MAE     0.2355   Time 399.934292
Sample size    512   iteration number    761   MSE     0.2000   MAE     0.2326   Time 395.360708
Sample size    512   iteration number    771   MSE     0.1981   MAE     0.2233   Time 410.983801
Sample size    512   iteration number    781   MSE     0.1610   MAE     0.2056   Time 397.418261
Sample size    512   iteration number    791   MSE     0.2380   MAE     0.2307   Time 408.945322
Sample size    512   iteration number    801   MSE     0.2119   MAE     0.2333   Time 395.168066
Sample size    512   iteration number    811   MSE     0.1932   MAE     0.2201   Time 408.631563
Sample size    512   iteration number    821   MSE     0.1893   MAE     0.2175   Time 408.479214
Sample size    512   iteration number    831   MSE     0.2008   MAE     0.2260   Time 408.297777
Sample size    512   iteration number    841   MSE     0.1613   MAE     0.2122   Time 409.871817
Sample size    512   iteration number    851   MSE     0.1669   MAE     0.2147   Time 425.161839
Sample size    512   iteration number    861   MSE     0.2215   MAE     0.2374   Time 427.391291
Sample size    512   iteration number    871   MSE     0.2175   MAE     0.2260   Time 409.779072
Sample size    512   iteration number    881   MSE     0.1759   MAE     0.2076   Time 411.607981
Sample size    512   iteration number    891   MSE     0.2180   MAE     0.2286   Time 425.058126
Sample size    512   iteration number    901   MSE     0.2052   MAE     0.2191   Time 425.294638
Sample size    512   iteration number    911   MSE     0.1841   MAE     0.2099   Time 408.998489
Sample size    512   iteration number    921   MSE     0.1730   MAE     0.2152   Time 410.136461
Sample size    512   iteration number    931   MSE     0.2258   MAE     0.2341   Time 409.790993
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Sample size    512   iteration number    941   MSE     0.1533   MAE     0.1981   Time 409.431458
Sample size    512   iteration number    951   MSE     0.2225   MAE     0.2327   Time 411.389112
Sample size    512   iteration number    961   MSE     0.1970   MAE     0.2244   Time 424.839020
Sample size    512   iteration number    971   MSE     0.1601   MAE     0.2045   Time 423.231363
Sample size    512   iteration number    981   MSE     0.1777   MAE     0.2136   Time 423.390150
Sample size    512   iteration number    991   MSE     0.2271   MAE     0.2376   Time 401.488543
Sample size    512   iteration number   1001   MSE     0.1892   MAE     0.2163   Time 409.257889
Sample size    512   iteration number   1011   MSE     0.2184   MAE     0.2329   Time 410.336494
Sample size    512   iteration number   1021   MSE     0.2120   MAE     0.2361   Time 427.171707
Sample size    512   iteration number   1031   MSE     0.2224   MAE     0.2330   Time 410.501480
Sample size    512   iteration number   1041   MSE     0.1727   MAE     0.2034   Time 407.704115
Sample size    512   iteration number   1051   MSE     0.2032   MAE     0.2191   Time 409.867287
Sample size    512   iteration number   1061   MSE     0.1871   MAE     0.2232   Time 410.129070
Sample size    512   iteration number   1071   MSE     0.2398   MAE     0.2437   Time 426.119328
Sample size    512   iteration number   1081   MSE     0.1753   MAE     0.2056   Time 399.269342
Sample size    512   iteration number   1091   MSE     0.1970   MAE     0.2264   Time 410.571814
Sample size    512   iteration number   1101   MSE     0.1770   MAE     0.2151   Time 424.144506
Sample size    512   iteration number   1111   MSE     0.2177   MAE     0.2329   Time 412.549496
Sample size    512   iteration number   1121   MSE     0.1578   MAE     0.2080   Time 410.294294
Sample size    512   iteration number   1131   MSE     0.2092   MAE     0.2215   Time 397.421598
Sample size    512   iteration number   1141   MSE     0.1769   MAE     0.2073   Time 424.998283
Sample size    512   iteration number   1151   MSE     0.1802   MAE     0.2137   Time 411.801338
Sample size    512   iteration number   1161   MSE     0.1898   MAE     0.2193   Time 426.153898
Sample size    512   iteration number   1171   MSE     0.1913   MAE     0.2289   Time 415.132761
Sample size    512   iteration number   1181   MSE     0.2013   MAE     0.2273   Time 424.697399
Sample size    512   iteration number   1191   MSE     0.1503   MAE     0.2047   Time 405.795574
Sample size    512   iteration number   1201   MSE     0.1718   MAE     0.2138   Time 409.631729
Sample size    512   iteration number   1211   MSE     0.2140   MAE     0.2342   Time 409.746170
Sample size    512   iteration number   1221   MSE     0.1846   MAE     0.2168   Time 410.778046
Sample size    512   iteration number   1231   MSE     0.1924   MAE     0.2174   Time 409.720421
Sample size    512   iteration number   1241   MSE     0.2174   MAE     0.2391   Time 411.556721
Sample size    512   iteration number   1251   MSE     0.1920   MAE     0.2188   Time 410.046101
Sample size    512   iteration number   1261   MSE     0.1923   MAE     0.2183   Time 409.927845
Sample size    512   iteration number   1271   MSE     0.1586   MAE     0.2039   Time 421.897173
Sample size    512   iteration number   1281   MSE     0.1770   MAE     0.2131   Time 411.184072
Sample size    512   iteration number   1291   MSE     0.1948   MAE     0.2180   Time 409.529924
Sample size    512   iteration number   1301   MSE     0.1588   MAE     0.2047   Time 397.067785
Sample size    512   iteration number   1311   MSE     0.2615   MAE     0.2500   Time 398.835659
Sample size    512   iteration number   1321   MSE     0.1775   MAE     0.2103   Time 408.262014
Sample size    512   iteration number   1331   MSE     0.2120   MAE     0.2220   Time 397.435904
Sample size    512   iteration number   1341   MSE     0.1740   MAE     0.2065   Time 409.893274
Sample size    512   iteration number   1351   MSE     0.2207   MAE     0.2277   Time 409.484863
Sample size    512   iteration number   1361   MSE     0.2013   MAE     0.2239   Time 395.353079
Sample size    512   iteration number   1371   MSE     0.1551   MAE     0.1979   Time 409.253359
Sample size    512   iteration number   1381   MSE     0.1974   MAE     0.2236   Time 415.000200
Sample size    512   iteration number   1391   MSE     0.1822   MAE     0.2173   Time 423.815727
Sample size    512   iteration number   1401   MSE     0.2114   MAE     0.2260   Time 411.355019
Sample size    512   iteration number   1411   MSE     0.1802   MAE     0.2096   Time 410.684109
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Sample size    512   iteration number   1421   MSE     0.1769   MAE     0.2093   Time 409.078836
Sample size    512   iteration number   1431   MSE     0.1978   MAE     0.2228   Time 407.860041
Sample size    512   iteration number   1441   MSE     0.2230   MAE     0.2335   Time 409.480810
Sample size    512   iteration number   1451   MSE     0.2034   MAE     0.2213   Time 408.907652
Sample size    512   iteration number   1461   MSE     0.1850   MAE     0.2115   Time 425.324678
Sample size    512   iteration number   1471   MSE     0.1938   MAE     0.2180   Time 411.200285
Sample size    512   iteration number   1481   MSE     0.2112   MAE     0.2232   Time 409.331799
Sample size    512   iteration number   1491   MSE     0.2207   MAE     0.2323   Time 425.908566
Sample size    512   iteration number   1501   MSE     0.2185   MAE     0.2346   Time 394.886971
Sample size    512   iteration number   1511   MSE     0.1751   MAE     0.2183   Time 409.860849
Sample size    512   iteration number   1521   MSE     0.1837   MAE     0.2099   Time 408.355474
Sample size    512   iteration number   1531   MSE     0.2108   MAE     0.2311   Time 417.579174
Sample size    512   iteration number   1541   MSE     0.1880   MAE     0.2174   Time 409.260035
Sample size    512   iteration number   1551   MSE     0.1818   MAE     0.2153   Time 396.025419
Sample size    512   iteration number   1561   MSE     0.1850   MAE     0.2155   Time 408.364534
Sample size    512   iteration number   1571   MSE     0.1954   MAE     0.2218   Time 398.452044
Sample size    512   iteration number   1581   MSE     0.1572   MAE     0.2034   Time 408.787727
Sample size    512   iteration number   1591   MSE     0.1864   MAE     0.2204   Time 409.541845
Sample size    512   iteration number   1601   MSE     0.1926   MAE     0.2202   Time 410.115480
Sample size    512   iteration number   1611   MSE     0.1409   MAE     0.1981   Time 410.313845
Sample size    512   iteration number   1621   MSE     0.1959   MAE     0.2117   Time 410.288572
Sample size    512   iteration number   1631   MSE     0.1406   MAE     0.1912   Time 396.777391
Sample size    512   iteration number   1641   MSE     0.1740   MAE     0.2050   Time 410.070181
Sample size    512   iteration number   1651   MSE     0.1749   MAE     0.2147   Time 411.552906
Sample size    512   iteration number   1661   MSE     0.2029   MAE     0.2289   Time 397.964716
Sample size    512   iteration number   1671   MSE     0.2249   MAE     0.2332   Time 411.160231
Sample size    512   iteration number   1681   MSE     0.2475   MAE     0.2316   Time 411.827564
Sample size    512   iteration number   1691   MSE     0.2440   MAE     0.2452   Time 409.304857
Sample size    512   iteration number   1701   MSE     0.1469   MAE     0.1907   Time 408.447027
Sample size    512   iteration number   1711   MSE     0.1738   MAE     0.2180   Time 410.286188
Sample size    512   iteration number   1721   MSE     0.1955   MAE     0.2209   Time 408.750772
Sample size    512   iteration number   1731   MSE     0.1675   MAE     0.2078   Time 410.279989
Sample size    512   iteration number   1741   MSE     0.1543   MAE     0.1976   Time 423.417568
Sample size    512   iteration number   1751   MSE     0.2069   MAE     0.2265   Time 394.491673
Sample size    512   iteration number   1761   MSE     0.2107   MAE     0.2286   Time 413.633347
Sample size    512   iteration number   1771   MSE     0.1614   MAE     0.2154   Time 408.572435
Sample size    512   iteration number   1781   MSE     0.2045   MAE     0.2286   Time 420.158148
Sample size    512   iteration number   1791   MSE     0.1677   MAE     0.2166   Time 413.040161
Sample size    512   iteration number   1801   MSE     0.1668   MAE     0.2068   Time 402.065754
Sample size    512   iteration number   1811   MSE     0.1771   MAE     0.2134   Time 422.905684
Sample size    512   iteration number   1821   MSE     0.2264   MAE     0.2412   Time 410.800219
Sample size    512   iteration number   1831   MSE     0.1818   MAE     0.2162   Time 417.174816
Sample size    512   iteration number   1841   MSE     0.1866   MAE     0.2175   Time 423.935890
Sample size    512   iteration number   1851   MSE     0.2028   MAE     0.2231   Time 409.264565
Sample size    512   iteration number   1861   MSE     0.1758   MAE     0.2087   Time 398.931503
Sample size    512   iteration number   1871   MSE     0.1580   MAE     0.1979   Time 409.816742
Sample size    512   iteration number   1881   MSE     0.1763   MAE     0.2119   Time 409.555912
Sample size    512   iteration number   1891   MSE     0.1748   MAE     0.2087   Time 409.952402
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Sample size    512   iteration number   1901   MSE     0.1754   MAE     0.2105   Time 410.357952
Sample size    512   iteration number   1911   MSE     0.1588   MAE     0.1973   Time 409.180403
Sample size    512   iteration number   1921   MSE     0.1478   MAE     0.1998   Time 412.968636
Sample size    512   iteration number   1931   MSE     0.1543   MAE     0.1976   Time 409.636021
Sample size    512   iteration number   1941   MSE     0.2241   MAE     0.2313   Time 411.420345
Sample size    512   iteration number   1951   MSE     0.1849   MAE     0.2174   Time 392.976999
Sample size    512   iteration number   1961   MSE     0.1726   MAE     0.2116   Time 410.191298
Sample size    512   iteration number   1971   MSE     0.1915   MAE     0.2147   Time 411.973238
Sample size    512   iteration number   1981   MSE     0.1711   MAE     0.2017   Time 425.604105
Sample size    512   iteration number   1991   MSE     0.1931   MAE     0.2209   Time 425.386190
Sample size    512   iteration number   2001   MSE     0.2042   MAE     0.2220   Time 395.479202
Sample size    512   iteration number   2011   MSE     0.2086   MAE     0.2293   Time 407.826662
Sample size    512   iteration number   2021   MSE     0.1697   MAE     0.2140   Time 393.693209
Sample size    512   iteration number   2031   MSE     0.2318   MAE     0.2361   Time 410.222769
Sample size    512   iteration number   2041   MSE     0.1493   MAE     0.1984   Time 409.917355
Sample size    512   iteration number   2051   MSE     0.1887   MAE     0.2190   Time 408.863068
Sample size    512   iteration number   2061   MSE     0.1711   MAE     0.2120   Time 408.878565
Sample size    512   iteration number   2071   MSE     0.1654   MAE     0.2052   Time 399.502516
Sample size    512   iteration number   2081   MSE     0.1451   MAE     0.1940   Time 408.243895
Sample size    512   iteration number   2091   MSE     0.1558   MAE     0.2005   Time 409.772396
Sample size    512   iteration number   2101   MSE     0.1786   MAE     0.2064   Time 396.480322
Sample size    512   iteration number   2111   MSE     0.1962   MAE     0.2182   Time 425.505400
Sample size    512   iteration number   2121   MSE     0.1568   MAE     0.1969   Time 411.452770
Sample size    512   iteration number   2131   MSE     0.1816   MAE     0.2083   Time 407.827854
Sample size    512   iteration number   2141   MSE     0.1968   MAE     0.2175   Time 422.307730
Sample size    512   iteration number   2151   MSE     0.1865   MAE     0.2105   Time 394.309282
Sample size    512   iteration number   2161   MSE     0.1743   MAE     0.2110   Time 410.778999
Sample size    512   iteration number   2171   MSE     0.1778   MAE     0.2090   Time 393.244743
Sample size    512   iteration number   2181   MSE     0.1649   MAE     0.2099   Time 396.486044
Sample size    512   iteration number   2191   MSE     0.2127   MAE     0.2231   Time 395.298958
Sample size    512   iteration number   2201   MSE     0.1710   MAE     0.2052   Time 411.265135
Sample size    512   iteration number   2211   MSE     0.1910   MAE     0.2216   Time 408.344030
Sample size    512   iteration number   2221   MSE     0.1745   MAE     0.2089   Time 419.979334
Sample size    512   iteration number   2231   MSE     0.2082   MAE     0.2244   Time 408.742428
Sample size    512   iteration number   2241   MSE     0.1799   MAE     0.2149   Time 410.214186
Sample size    512   iteration number   2251   MSE     0.1755   MAE     0.2158   Time 425.389767
Sample size    512   iteration number   2261   MSE     0.1886   MAE     0.2183   Time 423.193932
Sample size    512   iteration number   2271   MSE     0.2046   MAE     0.2217   Time 407.950640
Sample size    512   iteration number   2281   MSE     0.1759   MAE     0.2154   Time 409.369707
Sample size    512   iteration number   2291   MSE     0.1946   MAE     0.2155   Time 408.510923
Sample size    512   iteration number   2301   MSE     0.1610   MAE     0.1932   Time 408.632755
Sample size    512   iteration number   2311   MSE     0.1697   MAE     0.2031   Time 410.603762
Sample size    512   iteration number   2321   MSE     0.1771   MAE     0.2043   Time 409.516811
Sample size    512   iteration number   2331   MSE     0.1286   MAE     0.1812   Time 409.662724
Sample size    512   iteration number   2341   MSE     0.1947   MAE     0.2170   Time 408.427477
Sample size    512   iteration number   2351   MSE     0.1937   MAE     0.2157   Time 409.065962
Sample size    512   iteration number   2361   MSE     0.1440   MAE     0.1860   Time 407.303810
Sample size    512   iteration number   2371   MSE     0.1978   MAE     0.2126   Time 411.993027
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Sample size    512   iteration number   2381   MSE     0.1528   MAE     0.1995   Time 414.652824
Sample size    512   iteration number   2391   MSE     0.2301   MAE     0.2346   Time 413.823366
Sample size    512   iteration number   2401   MSE     0.1580   MAE     0.1902   Time 412.339211
Sample size    512   iteration number   2411   MSE     0.1666   MAE     0.2096   Time 415.415049
Sample size    512   iteration number   2421   MSE     0.2036   MAE     0.2176   Time 426.908493
Sample size    512   iteration number   2431   MSE     0.1368   MAE     0.1903   Time 410.772800
Sample size    512   iteration number   2441   MSE     0.1687   MAE     0.2125   Time 425.887108
Sample size    512   iteration number   2451   MSE     0.1991   MAE     0.2204   Time 409.676075
Sample size    512   iteration number   2461   MSE     0.1794   MAE     0.2068   Time 410.015583
Sample size    512   iteration number   2471   MSE     0.1760   MAE     0.2115   Time 409.651279
Sample size    512   iteration number   2481   MSE     0.1857   MAE     0.2144   Time 395.461798
Sample size    512   iteration number   2491   MSE     0.2166   MAE     0.2212   Time 423.805237
Sample size    512   iteration number   2501   MSE     0.1740   MAE     0.2072   Time 411.622286
Sample size    512   iteration number   2511   MSE     0.2114   MAE     0.2192   Time 409.466028
Sample size    512   iteration number   2521   MSE     0.1695   MAE     0.2043   Time 397.157907
Sample size    512   iteration number   2531   MSE     0.2010   MAE     0.2188   Time 407.376289
Sample size    512   iteration number   2541   MSE     0.1883   MAE     0.2107   Time 412.001371
Sample size    512   iteration number   2551   MSE     0.1522   MAE     0.1972   Time 410.801411
Sample size    512   iteration number   2561   MSE     0.1848   MAE     0.2158   Time 396.785259
Sample size    512   iteration number   2571   MSE     0.1633   MAE     0.2082   Time 411.965370
Sample size    512   iteration number   2581   MSE     0.1833   MAE     0.2133   Time 409.624815
Sample size    512   iteration number   2591   MSE     0.1501   MAE     0.2001   Time 394.247770
Sample size    512   iteration number   2601   MSE     0.1571   MAE     0.2032   Time 395.317078
Sample size    512   iteration number   2611   MSE     0.1692   MAE     0.2045   Time 412.298441
Sample size    512   iteration number   2621   MSE     0.1796   MAE     0.2082   Time 410.517216
Sample size    512   iteration number   2631   MSE     0.1706   MAE     0.2053   Time 398.679495
Sample size    512   iteration number   2641   MSE     0.2263   MAE     0.2363   Time 411.905050
Sample size    512   iteration number   2651   MSE     0.1604   MAE     0.2063   Time 397.905588
Sample size    512   iteration number   2661   MSE     0.1950   MAE     0.2099   Time 396.976709
Sample size    512   iteration number   2671   MSE     0.2117   MAE     0.2256   Time 408.543348
Sample size    512   iteration number   2681   MSE     0.2121   MAE     0.2292   Time 411.488295
Sample size    512   iteration number   2691   MSE     0.1416   MAE     0.1899   Time 411.076069
Sample size    512   iteration number   2701   MSE     0.1955   MAE     0.2200   Time 421.664715
Sample size    512   iteration number   2711   MSE     0.1711   MAE     0.2043   Time 409.914494
Sample size    512   iteration number   2721   MSE     0.1666   MAE     0.2077   Time 411.685228
Sample size    512   iteration number   2731   MSE     0.2133   MAE     0.2256   Time 424.760103
Sample size    512   iteration number   2741   MSE     0.1841   MAE     0.2099   Time 399.041414
Sample size    512   iteration number   2751   MSE     0.1499   MAE     0.1945   Time 395.467520
Sample size    512   iteration number   2761   MSE     0.1515   MAE     0.1953   Time 409.211159
Sample size    512   iteration number   2771   MSE     0.1484   MAE     0.1999   Time 411.277533
Sample size    512   iteration number   2781   MSE     0.1703   MAE     0.2109   Time 418.612003
Sample size    512   iteration number   2791   MSE     0.1668   MAE     0.2039   Time 395.527601
Sample size    512   iteration number   2801   MSE     0.1711   MAE     0.2059   Time 409.542322
Sample size    512   iteration number   2811   MSE     0.1991   MAE     0.2262   Time 407.600641
Sample size    512   iteration number   2821   MSE     0.1578   MAE     0.2017   Time 408.799410
Sample size    512   iteration number   2831   MSE     0.1529   MAE     0.1940   Time 414.277554
Sample size    512   iteration number   2841   MSE     0.1555   MAE     0.2004   Time 410.716295
Sample size    512   iteration number   2851   MSE     0.1820   MAE     0.2131   Time 423.361063
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Sample size    512   iteration number   2861   MSE     0.1571   MAE     0.1959   Time 409.412861
Sample size    512   iteration number   2871   MSE     0.1394   MAE     0.1847   Time 423.789263
Sample size    512   iteration number   2881   MSE     0.1981   MAE     0.2185   Time 409.999609
Sample size    512   iteration number   2891   MSE     0.1508   MAE     0.1972   Time 408.921719
Sample size    512   iteration number   2901   MSE     0.1899   MAE     0.2183   Time 411.709785
Sample size    512   iteration number   2911   MSE     0.1880   MAE     0.2165   Time 406.205654
Sample size    512   iteration number   2921   MSE     0.1704   MAE     0.2093   Time 425.517321
Sample size    512   iteration number   2931   MSE     0.2118   MAE     0.2233   Time 411.635399
Sample size    512   iteration number   2941   MSE     0.2270   MAE     0.2255   Time 407.879591
Sample size    512   iteration number   2951   MSE     0.2035   MAE     0.2216   Time 410.937309
Sample size    512   iteration number   2961   MSE     0.1834   MAE     0.2050   Time 409.693003
Sample size    512   iteration number   2971   MSE     0.1683   MAE     0.2057   Time 412.298679
Sample size    512   iteration number   2981   MSE     0.1432   MAE     0.1903   Time 408.653021
Sample size    512   iteration number   2991   MSE     0.1335   MAE     0.1832   Time 409.659386
Sample size    512   iteration number   3001   MSE     0.2001   MAE     0.2236   Time 423.582315
Sample size   2048   iteration number      1   MSE     0.1772   MAE     0.2105   Time 1288.83433
Sample size   2048   iteration number     11   MSE     0.1775   MAE     0.2033   Time 1288.16390
Sample size   2048   iteration number     21   MSE     0.1731   MAE     0.2034   Time 1293.86043
Sample size   2048   iteration number     31   MSE     0.1737   MAE     0.2016   Time 1287.21642
Sample size   2048   iteration number     41   MSE     0.1687   MAE     0.2013   Time 1288.35153
Sample size   2048   iteration number     51   MSE     0.1762   MAE     0.2013   Time 1293.14446
Sample size   2048   iteration number     61   MSE     0.1682   MAE     0.1999   Time 1283.76865
Sample size   2048   iteration number     71   MSE     0.1735   MAE     0.2024   Time 1301.53369
Sample size   2048   iteration number     81   MSE     0.1590   MAE     0.1961   Time 1290.61460
Sample size   2048   iteration number     91   MSE     0.1735   MAE     0.1980   Time 1284.09576
Sample size   2048   iteration number    101   MSE     0.1547   MAE     0.1905   Time 1285.76803
Sample size   2048   iteration number    111   MSE     0.1645   MAE     0.1969   Time 1290.37785
Sample size   2048   iteration number    121   MSE     0.1511   MAE     0.1896   Time 1289.51621
Sample size   2048   iteration number    131   MSE     0.1669   MAE     0.1979   Time 1287.47844
Sample size   2048   iteration number    141   MSE     0.1497   MAE     0.1898   Time 1291.50009
Sample size   2048   iteration number    151   MSE     0.1525   MAE     0.1909   Time 1282.41705
Sample size   2048   iteration number    161   MSE     0.1554   MAE     0.1912   Time 1288.17272
Sample size   2048   iteration number    171   MSE     0.1551   MAE     0.1898   Time 1290.01617
Sample size   2048   iteration number    181   MSE     0.1702   MAE     0.1944   Time 1287.98961
Sample size   2048   iteration number    191   MSE     0.1520   MAE     0.1876   Time 1293.51234
Sample size   2048   iteration number    201   MSE     0.1751   MAE     0.1994   Time 1283.73456
Sample size   2048   iteration number    211   MSE     0.1492   MAE     0.1860   Time 1291.24712
Sample size   2048   iteration number    221   MSE     0.1584   MAE     0.1943   Time 1284.55448
Sample size   2048   iteration number    231   MSE     0.1721   MAE     0.1922   Time 1288.82098
Sample size   2048   iteration number    241   MSE     0.1577   MAE     0.1931   Time 1297.81532
Sample size   2048   iteration number    251   MSE     0.1494   MAE     0.1900   Time 1286.49973
Sample size   2048   iteration number    261   MSE     0.1598   MAE     0.1897   Time 1312.86454
Sample size   2048   iteration number    271   MSE     0.1688   MAE     0.1971   Time 1288.50626
Sample size   2048   iteration number    281   MSE     0.1656   MAE     0.1967   Time 1294.01397
Sample size   2048   iteration number    291   MSE     0.1671   MAE     0.1968   Time 1286.23843
Sample size   2048   iteration number    301   MSE     0.1625   MAE     0.1920   Time 1292.58155
Sample size   2048   iteration number    311   MSE     0.1618   MAE     0.1907   Time 1291.43953
Sample size   2048   iteration number    321   MSE     0.1456   MAE     0.1862   Time 1283.31160
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Sample size   2048   iteration number    331   MSE     0.1566   MAE     0.1897   Time 1293.01428
Sample size   2048   iteration number    341   MSE     0.1513   MAE     0.1883   Time 1286.54813
Sample size   2048   iteration number    351   MSE     0.1834   MAE     0.2006   Time 1289.95990
Sample size   2048   iteration number    361   MSE     0.1589   MAE     0.1885   Time 1287.61601
Sample size   2048   iteration number    371   MSE     0.1616   MAE     0.1924   Time 1290.71068
Sample size   2048   iteration number    381   MSE     0.1586   MAE     0.1871   Time 1289.61205
Sample size   2048   iteration number    391   MSE     0.1668   MAE     0.1949   Time 1288.28001
Sample size   2048   iteration number    401   MSE     0.1717   MAE     0.1956   Time 1286.21721
Sample size   2048   iteration number    411   MSE     0.1773   MAE     0.2021   Time 1293.00928
Sample size   2048   iteration number    421   MSE     0.1586   MAE     0.1880   Time 1287.19091
Sample size   2048   iteration number    431   MSE     0.1517   MAE     0.1887   Time 1290.29083
Sample size   2048   iteration number    441   MSE     0.1628   MAE     0.1930   Time 1290.05026
Sample size   2048   iteration number    451   MSE     0.1576   MAE     0.1880   Time 1292.16194
Sample size   2048   iteration number    461   MSE     0.1527   MAE     0.1859   Time 1292.20938
Sample size   2048   iteration number    471   MSE     0.1561   MAE     0.1912   Time 1284.06024
Sample size   2048   iteration number    481   MSE     0.1524   MAE     0.1881   Time 1288.59877
Sample size   2048   iteration number    491   MSE     0.1462   MAE     0.1871   Time 1288.27452
Sample size   2048   iteration number    501   MSE     0.1503   MAE     0.1870   Time 1290.45724
Sample size   2048   iteration number    511   MSE     0.1499   MAE     0.1872   Time 1292.57226
Sample size   2048   iteration number    521   MSE     0.1507   MAE     0.1832   Time 1288.81120
Sample size   2048   iteration number    531   MSE     0.1643   MAE     0.1949   Time 1290.64989
Sample size   2048   iteration number    541   MSE     0.1600   MAE     0.1882   Time 1297.38593
Sample size   2048   iteration number    551   MSE     0.1507   MAE     0.1890   Time 1290.23003
Sample size   2048   iteration number    561   MSE     0.1664   MAE     0.1938   Time 1288.99598
Sample size   2048   iteration number    571   MSE     0.1372   MAE     0.1794   Time 1287.13870
Sample size   2048   iteration number    581   MSE     0.1496   MAE     0.1877   Time 1291.35370
Sample size   2048   iteration number    591   MSE     0.1393   MAE     0.1805   Time 1291.00704
Sample size   2048   iteration number    601   MSE     0.1338   MAE     0.1772   Time 1291.21136
Sample size   2048   iteration number    611   MSE     0.1720   MAE     0.1948   Time 1291.63718
Sample size   2048   iteration number    621   MSE     0.1486   MAE     0.1879   Time 1288.46383
Sample size   2048   iteration number    631   MSE     0.1403   MAE     0.1821   Time 1296.62299
Sample size   2048   iteration number    641   MSE     0.1629   MAE     0.1971   Time 1289.62564
Sample size   2048   iteration number    651   MSE     0.1505   MAE     0.1863   Time 1288.21301
Sample size   2048   iteration number    661   MSE     0.1499   MAE     0.1881   Time 1284.79242
Sample size   2048   iteration number    671   MSE     0.1360   MAE     0.1797   Time 1286.99469
Sample size   2048   iteration number    681   MSE     0.1547   MAE     0.1935   Time 1302.08015
Sample size   2048   iteration number    691   MSE     0.1424   MAE     0.1824   Time 1285.46905
Sample size   2048   iteration number    701   MSE     0.1535   MAE     0.1848   Time 1291.19396
Sample size   2048   iteration number    711   MSE     0.1513   MAE     0.1869   Time 1286.36193
Sample size   2048   iteration number    721   MSE     0.1462   MAE     0.1831   Time 1280.91621
Sample size   2048   iteration number    731   MSE     0.1657   MAE     0.1909   Time 1287.53924
Sample size   2048   iteration number    741   MSE     0.1318   MAE     0.1762   Time 1283.98752
Sample size   2048   iteration number    751   MSE     0.1463   MAE     0.1833   Time 1295.93110
Sample size   2048   iteration number    761   MSE     0.1392   MAE     0.1826   Time 1288.85269
Sample size   2048   iteration number    771   MSE     0.1389   MAE     0.1791   Time 1289.31975
Sample size   2048   iteration number    781   MSE     0.1533   MAE     0.1860   Time 1290.03262
Sample size   2048   iteration number    791   MSE     0.1501   MAE     0.1859   Time 1295.71080
Sample size   2048   iteration number    801   MSE     0.1501   MAE     0.1863   Time 1288.85889
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Sample size   2048   iteration number    811   MSE     0.1462   MAE     0.1843   Time 1288.14959
Sample size   2048   iteration number    821   MSE     0.1560   MAE     0.1912   Time 1289.88456
Sample size   2048   iteration number    831   MSE     0.1589   MAE     0.1879   Time 1288.39492
Sample size   2048   iteration number    841   MSE     0.1432   MAE     0.1831   Time 1285.11428
Sample size   2048   iteration number    851   MSE     0.1402   MAE     0.1829   Time 1286.21983
Sample size   2048   iteration number    861   MSE     0.1429   MAE     0.1795   Time 1286.60130
Sample size   2048   iteration number    871   MSE     0.1467   MAE     0.1839   Time 1297.19376
Sample size   2048   iteration number    881   MSE     0.1482   MAE     0.1869   Time 1288.99383
Sample size   2048   iteration number    891   MSE     0.1271   MAE     0.1746   Time 1287.47534
Sample size   2048   iteration number    901   MSE     0.1477   MAE     0.1822   Time 1290.11583
Sample size   2048   iteration number    911   MSE     0.1748   MAE     0.1935   Time 1287.48917
Sample size   2048   iteration number    921   MSE     0.1397   MAE     0.1798   Time 1292.44947
Sample size   2048   iteration number    931   MSE     0.1414   MAE     0.1799   Time 1289.13307
Sample size   2048   iteration number    941   MSE     0.1535   MAE     0.1818   Time 1286.82398
Sample size   2048   iteration number    951   MSE     0.1334   MAE     0.1768   Time 1291.68629
Sample size   2048   iteration number    961   MSE     0.1468   MAE     0.1808   Time 1292.74487
Sample size   2048   iteration number    971   MSE     0.1387   MAE     0.1787   Time 1290.71474
Sample size   2048   iteration number    981   MSE     0.1357   MAE     0.1795   Time 1294.17181
Sample size   2048   iteration number    991   MSE     0.1414   MAE     0.1811   Time 1288.22374
Sample size   2048   iteration number   1001   MSE     0.1355   MAE     0.1758   Time 1294.06356
Sample size   2048   iteration number   1011   MSE     0.1529   MAE     0.1841   Time 1290.15207
Sample size   2048   iteration number   1021   MSE     0.1422   MAE     0.1824   Time 1285.88581
Sample size   2048   iteration number   1031   MSE     0.1530   MAE     0.1894   Time 1292.90986
Sample size   2048   iteration number   1041   MSE     0.1458   MAE     0.1802   Time 1295.48978
Sample size   2048   iteration number   1051   MSE     0.1196   MAE     0.1672   Time 1287.26100
Sample size   2048   iteration number   1061   MSE     0.1413   MAE     0.1784   Time 1292.36340
Sample size   2048   iteration number   1071   MSE     0.1282   MAE     0.1725   Time 1285.95900
Sample size   2048   iteration number   1081   MSE     0.1462   MAE     0.1854   Time 1286.26489
Sample size   2048   iteration number   1091   MSE     0.1395   MAE     0.1816   Time 1293.16473
Sample size   2048   iteration number   1101   MSE     0.1307   MAE     0.1770   Time 1287.28604
Sample size   2048   iteration number   1111   MSE     0.1468   MAE     0.1813   Time 1292.42062
Sample size   2048   iteration number   1121   MSE     0.1443   MAE     0.1806   Time 1288.59806
Sample size   2048   iteration number   1131   MSE     0.1489   MAE     0.1826   Time 1291.58759
Sample size   2048   iteration number   1141   MSE     0.1630   MAE     0.1889   Time 1285.52508
Sample size   2048   iteration number   1151   MSE     0.1476   MAE     0.1830   Time 1290.24171
Sample size   2048   iteration number   1161   MSE     0.1403   MAE     0.1789   Time 1296.69952
Sample size   2048   iteration number   1171   MSE     0.1342   MAE     0.1750   Time 1287.49156
Sample size   2048   iteration number   1181   MSE     0.1627   MAE     0.1898   Time 1285.81881
Sample size   2048   iteration number   1191   MSE     0.1363   MAE     0.1776   Time 1312.23011
Sample size   2048   iteration number   1201   MSE     0.1423   MAE     0.1846   Time 1287.55211
Sample size   2048   iteration number   1211   MSE     0.1479   MAE     0.1829   Time 1293.71500
Sample size   2048   iteration number   1221   MSE     0.1518   MAE     0.1865   Time 1287.94598
Sample size   2048   iteration number   1231   MSE     0.1518   MAE     0.1865   Time 1288.86294
Sample size   2048   iteration number   1241   MSE     0.1476   MAE     0.1845   Time 1290.68970
Sample size   2048   iteration number   1251   MSE     0.1648   MAE     0.1895   Time 1294.04783
Sample size   2048   iteration number   1261   MSE     0.1337   MAE     0.1766   Time 1294.40045
Sample size   2048   iteration number   1271   MSE     0.1343   MAE     0.1791   Time 1307.66820
Sample size   2048   iteration number   1281   MSE     0.1538   MAE     0.1822   Time 1292.55366
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Sample size   2048   iteration number   1291   MSE     0.1373   MAE     0.1766   Time 1286.56697
Sample size   2048   iteration number   1301   MSE     0.1206   MAE     0.1699   Time 1291.39494
Sample size   2048   iteration number   1311   MSE     0.1441   MAE     0.1781   Time 1287.86826
Sample size   2048   iteration number   1321   MSE     0.1212   MAE     0.1683   Time 1283.75124
Sample size   2048   iteration number   1331   MSE     0.1335   MAE     0.1759   Time 1289.60728
Sample size   2048   iteration number   1341   MSE     0.1351   MAE     0.1742   Time 1290.52209
Sample size   2048   iteration number   1351   MSE     0.1529   MAE     0.1831   Time 1291.12672
Sample size   2048   iteration number   1361   MSE     0.1399   MAE     0.1766   Time 1285.37178
Sample size   2048   iteration number   1371   MSE     0.1481   MAE     0.1848   Time 1284.51776
Sample size   2048   iteration number   1381   MSE     0.1423   MAE     0.1803   Time 1289.96229
Sample size   2048   iteration number   1391   MSE     0.1358   MAE     0.1750   Time 1284.31749
Sample size   2048   iteration number   1401   MSE     0.1496   MAE     0.1846   Time 1287.10007
Sample size   2048   iteration number   1411   MSE     0.1289   MAE     0.1767   Time 1285.43448
Sample size   2048   iteration number   1421   MSE     0.1455   MAE     0.1832   Time 1290.07697
Sample size   2048   iteration number   1431   MSE     0.1607   MAE     0.1914   Time 1288.39969
Sample size   2048   iteration number   1441   MSE     0.1356   MAE     0.1797   Time 1289.34907
Sample size   2048   iteration number   1451   MSE     0.1428   MAE     0.1776   Time 1294.81959
Sample size   2048   iteration number   1461   MSE     0.1516   MAE     0.1866   Time 1290.50135
Sample size   2048   iteration number   1471   MSE     0.1420   MAE     0.1819   Time 1292.06585
Sample size   2048   iteration number   1481   MSE     0.1340   MAE     0.1799   Time 1286.95249
Sample size   2048   iteration number   1491   MSE     0.1465   MAE     0.1842   Time 1289.68358
Sample size   2048   iteration number   1501   MSE     0.1372   MAE     0.1811   Time 1290.13538
Sample size   2048   iteration number   1511   MSE     0.1230   MAE     0.1717   Time 1288.18178
Sample size   2048   iteration number   1521   MSE     0.1368   MAE     0.1814   Time 1288.27953
Sample size   2048   iteration number   1531   MSE     0.1574   MAE     0.1898   Time 1286.02004
Sample size   2048   iteration number   1541   MSE     0.1466   MAE     0.1867   Time 1293.13898
Sample size   2048   iteration number   1551   MSE     0.1311   MAE     0.1709   Time 1289.96515
Sample size   2048   iteration number   1561   MSE     0.1408   MAE     0.1798   Time 1280.94339
Sample size   2048   iteration number   1571   MSE     0.1366   MAE     0.1748   Time 1283.66041
Sample size   2048   iteration number   1581   MSE     0.1337   MAE     0.1763   Time 1286.87620
Sample size   2048   iteration number   1591   MSE     0.1460   MAE     0.1817   Time 1288.40136
Sample size   2048   iteration number   1601   MSE     0.1496   MAE     0.1831   Time 1292.37008
Sample size   2048   iteration number   1611   MSE     0.1191   MAE     0.1685   Time 1285.51101
Sample size   2048   iteration number   1621   MSE     0.1439   MAE     0.1810   Time 1299.17573
Sample size   2048   iteration number   1631   MSE     0.1306   MAE     0.1749   Time 1287.90807
Sample size   2048   iteration number   1641   MSE     0.1463   MAE     0.1818   Time 1282.50837
Sample size   2048   iteration number   1651   MSE     0.1493   MAE     0.1830   Time 1293.10178
Sample size   2048   iteration number   1661   MSE     0.1457   MAE     0.1799   Time 1285.23445
Sample size   2048   iteration number   1671   MSE     0.1337   MAE     0.1755   Time 1288.17796
Sample size   2048   iteration number   1681   MSE     0.1449   MAE     0.1790   Time 1280.72691
Sample size   2048   iteration number   1691   MSE     0.1394   MAE     0.1788   Time 1284.88969
Sample size   2048   iteration number   1701   MSE     0.1397   MAE     0.1805   Time 1288.23852
Sample size   2048   iteration number   1711   MSE     0.1350   MAE     0.1743   Time 1284.83915
Sample size   2048   iteration number   1721   MSE     0.1385   MAE     0.1820   Time 1283.37764
Sample size   2048   iteration number   1731   MSE     0.1336   MAE     0.1743   Time 1287.42432
Sample size   2048   iteration number   1741   MSE     0.1295   MAE     0.1735   Time 1292.68479
Sample size   2048   iteration number   1751   MSE     0.1383   MAE     0.1771   Time 1283.48207
Sample size   2048   iteration number   1761   MSE     0.1370   MAE     0.1725   Time 1285.48431
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Sample size   2048   iteration number   1771   MSE     0.1430   MAE     0.1810   Time 1289.35933
Sample size   2048   iteration number   1781   MSE     0.1288   MAE     0.1729   Time 1295.35079
Sample size   2048   iteration number   1791   MSE     0.1180   MAE     0.1687   Time 1290.73834
Sample size   2048   iteration number   1801   MSE     0.1409   MAE     0.1801   Time 1285.01677
Sample size   2048   iteration number   1811   MSE     0.1198   MAE     0.1688   Time 1286.90505
Sample size   2048   iteration number   1821   MSE     0.1341   MAE     0.1783   Time 1290.16900
Sample size   2048   iteration number   1831   MSE     0.1299   MAE     0.1728   Time 1291.39256
Sample size   2048   iteration number   1841   MSE     0.1444   MAE     0.1815   Time 1304.98218
Sample size   2048   iteration number   1851   MSE     0.1523   MAE     0.1874   Time 1290.81511
Sample size   2048   iteration number   1861   MSE     0.1364   MAE     0.1773   Time 1294.50011
Sample size   2048   iteration number   1871   MSE     0.1418   MAE     0.1804   Time 1291.63813
Sample size   2048   iteration number   1881   MSE     0.1418   MAE     0.1806   Time 1288.48528
Sample size   2048   iteration number   1891   MSE     0.1394   MAE     0.1793   Time 1292.16551
Sample size   2048   iteration number   1901   MSE     0.1390   MAE     0.1807   Time 1288.20371
Sample size   2048   iteration number   1911   MSE     0.1470   MAE     0.1805   Time 1293.13993
Sample size   2048   iteration number   1921   MSE     0.1462   MAE     0.1810   Time 1289.81304
Sample size   2048   iteration number   1931   MSE     0.1426   MAE     0.1818   Time 1288.00511
Sample size   2048   iteration number   1941   MSE     0.1427   MAE     0.1784   Time 1295.55010
Sample size   2048   iteration number   1951   MSE     0.1485   MAE     0.1818   Time 1290.75288
Sample size   2048   iteration number   1961   MSE     0.1369   MAE     0.1783   Time 1287.91475
Sample size   2048   iteration number   1971   MSE     0.1321   MAE     0.1731   Time 1291.84436
Sample size   2048   iteration number   1981   MSE     0.1447   MAE     0.1810   Time 1286.45849
Sample size   2048   iteration number   1991   MSE     0.1254   MAE     0.1714   Time 1294.33631
Sample size   2048   iteration number   2001   MSE     0.1485   MAE     0.1859   Time 1286.09466
Sample size   2048   iteration number   2011   MSE     0.1499   MAE     0.1851   Time 1291.07856
Sample size   2048   iteration number   2021   MSE     0.1266   MAE     0.1710   Time 1295.85909
Sample size   2048   iteration number   2031   MSE     0.1256   MAE     0.1726   Time 1284.94572
Sample size   2048   iteration number   2041   MSE     0.1484   MAE     0.1810   Time 1291.90826
Sample size   2048   iteration number   2051   MSE     0.1437   MAE     0.1813   Time 1286.61847
Sample size   2048   iteration number   2061   MSE     0.1386   MAE     0.1795   Time 1288.53964
Sample size   2048   iteration number   2071   MSE     0.1337   MAE     0.1769   Time 1290.50254
Sample size   2048   iteration number   2081   MSE     0.1318   MAE     0.1739   Time 1297.13320
Sample size   2048   iteration number   2091   MSE     0.1569   MAE     0.1871   Time 1285.81738
Sample size   2048   iteration number   2101   MSE     0.1470   MAE     0.1851   Time 1290.39907
Sample size   2048   iteration number   2111   MSE     0.1269   MAE     0.1714   Time 1289.64996
Sample size   2048   iteration number   2121   MSE     0.1248   MAE     0.1706   Time 1304.53658
Sample size   2048   iteration number   2131   MSE     0.1407   MAE     0.1800   Time 1290.90118
Sample size   2048   iteration number   2141   MSE     0.1476   MAE     0.1874   Time 1288.86008
Sample size   2048   iteration number   2151   MSE     0.1476   MAE     0.1823   Time 1288.15817
Sample size   2048   iteration number   2161   MSE     0.1511   MAE     0.1827   Time 1289.54434
Sample size   2048   iteration number   2171   MSE     0.1332   MAE     0.1731   Time 1286.07749
Sample size   2048   iteration number   2181   MSE     0.1403   MAE     0.1793   Time 1291.40472
Sample size   2048   iteration number   2191   MSE     0.1386   MAE     0.1797   Time 1294.42358
Sample size   2048   iteration number   2201   MSE     0.1311   MAE     0.1745   Time 1294.08407
Sample size   2048   iteration number   2211   MSE     0.1188   MAE     0.1697   Time 1292.84787
Sample size   2048   iteration number   2221   MSE     0.1389   MAE     0.1787   Time 1294.69466
Sample size   2048   iteration number   2231   MSE     0.1335   MAE     0.1740   Time 1290.37189
Sample size   2048   iteration number   2241   MSE     0.1260   MAE     0.1718   Time 1289.99877
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Sample size   2048   iteration number   2251   MSE     0.1276   MAE     0.1774   Time 1282.98187
Sample size   2048   iteration number   2261   MSE     0.1453   MAE     0.1780   Time 1290.45558
Sample size   2048   iteration number   2271   MSE     0.1405   MAE     0.1776   Time 1284.17420
Sample size   2048   iteration number   2281   MSE     0.1216   MAE     0.1692   Time 1289.60752
Sample size   2048   iteration number   2291   MSE     0.1380   MAE     0.1786   Time 1287.29701
Sample size   2048   iteration number   2301   MSE     0.1276   MAE     0.1760   Time 1293.36810
Sample size   2048   iteration number   2311   MSE     0.1309   MAE     0.1742   Time 1293.28537
Sample size   2048   iteration number   2321   MSE     0.1286   MAE     0.1731   Time 1303.56431
Sample size   2048   iteration number   2331   MSE     0.1581   MAE     0.1886   Time 1291.02277
Sample size   2048   iteration number   2341   MSE     0.1329   MAE     0.1794   Time 1295.74298
Sample size   2048   iteration number   2351   MSE     0.1225   MAE     0.1692   Time 1284.10673
Sample size   2048   iteration number   2361   MSE     0.1227   MAE     0.1741   Time 1285.10165
Sample size   2048   iteration number   2371   MSE     0.1280   MAE     0.1754   Time 1356.32729
Sample size   2048   iteration number   2381   MSE     0.1406   MAE     0.1797   Time 1289.22557
Sample size   2048   iteration number   2391   MSE     0.1485   MAE     0.1821   Time 1291.01085
Sample size   2048   iteration number   2401   MSE     0.1403   MAE     0.1793   Time 1288.70749
Sample size   2048   iteration number   2411   MSE     0.1358   MAE     0.1764   Time 1292.57869
Sample size   2048   iteration number   2421   MSE     0.1353   MAE     0.1797   Time 1294.74282
Sample size   2048   iteration number   2431   MSE     0.1283   MAE     0.1773   Time 1289.38102
Sample size   2048   iteration number   2441   MSE     0.1312   MAE     0.1785   Time 1296.18144
Sample size   2048   iteration number   2451   MSE     0.1311   MAE     0.1738   Time 1291.32390
Sample size   2048   iteration number   2461   MSE     0.1183   MAE     0.1700   Time 1288.62619
Sample size   2048   iteration number   2471   MSE     0.1386   MAE     0.1786   Time 1292.93179
Sample size   2048   iteration number   2481   MSE     0.1215   MAE     0.1720   Time 1292.69099
Sample size   2048   iteration number   2491   MSE     0.1262   MAE     0.1717   Time 1313.37094
Sample size   2048   iteration number   2501   MSE     0.1229   MAE     0.1733   Time 1286.29779
Sample size   2048   iteration number   2511   MSE     0.1393   MAE     0.1791   Time 1287.30750
Sample size   2048   iteration number   2521   MSE     0.1603   MAE     0.1855   Time 1288.50221
Sample size   2048   iteration number   2531   MSE     0.1331   MAE     0.1730   Time 1284.52110
Sample size   2048   iteration number   2541   MSE     0.1318   MAE     0.1782   Time 1292.35601
Sample size   2048   iteration number   2551   MSE     0.1271   MAE     0.1717   Time 1293.95866
Sample size   2048   iteration number   2561   MSE     0.1249   MAE     0.1720   Time 1287.78505
Sample size   2048   iteration number   2571   MSE     0.1194   MAE     0.1659   Time 1289.59775
Sample size   2048   iteration number   2581   MSE     0.1359   MAE     0.1757   Time 1291.10550
Sample size   2048   iteration number   2591   MSE     0.1256   MAE     0.1707   Time 1288.16056
Sample size   2048   iteration number   2601   MSE     0.1273   MAE     0.1714   Time 1308.58492
Sample size   2048   iteration number   2611   MSE     0.1406   MAE     0.1786   Time 1289.36338
Sample size   2048   iteration number   2621   MSE     0.1249   MAE     0.1703   Time 1287.88209
Sample size   2048   iteration number   2631   MSE     0.1384   MAE     0.1807   Time 1286.40079
Sample size   2048   iteration number   2641   MSE     0.1528   MAE     0.1835   Time 1292.16337
Sample size   2048   iteration number   2651   MSE     0.1426   MAE     0.1794   Time 1290.83275
Sample size   2048   iteration number   2661   MSE     0.1402   MAE     0.1808   Time 1289.10684
Sample size   2048   iteration number   2671   MSE     0.1235   MAE     0.1733   Time 1297.68848
Sample size   2048   iteration number   2681   MSE     0.1317   MAE     0.1720   Time 1288.27595
Sample size   2048   iteration number   2691   MSE     0.1202   MAE     0.1702   Time 1291.89086
Sample size   2048   iteration number   2701   MSE     0.1255   MAE     0.1727   Time 1290.97104
Sample size   2048   iteration number   2711   MSE     0.1217   MAE     0.1721   Time 1286.08775
Sample size   2048   iteration number   2721   MSE     0.1257   MAE     0.1681   Time 1287.69040
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Sample size   2048   iteration number   2731   MSE     0.1287   MAE     0.1740   Time 1294.33012
Sample size   2048   iteration number   2741   MSE     0.1350   MAE     0.1814   Time 1287.85729
Sample size   2048   iteration number   2751   MSE     0.1125   MAE     0.1652   Time 1286.07416
Sample size   2048   iteration number   2761   MSE     0.1308   MAE     0.1740   Time 1288.75446
Sample size   2048   iteration number   2771   MSE     0.1331   MAE     0.1766   Time 1298.22778
Sample size   2048   iteration number   2781   MSE     0.1366   MAE     0.1770   Time 1288.33556
Sample size   2048   iteration number   2791   MSE     0.1403   MAE     0.1798   Time 1288.26904
Sample size   2048   iteration number   2801   MSE     0.1260   MAE     0.1754   Time 1289.36648
Sample size   2048   iteration number   2811   MSE     0.1259   MAE     0.1735   Time 1286.77940
Sample size   2048   iteration number   2821   MSE     0.1629   MAE     0.1936   Time 1287.52017
Sample size   2048   iteration number   2831   MSE     0.1349   MAE     0.1777   Time 1290.30752
Sample size   2048   iteration number   2841   MSE     0.1161   MAE     0.1657   Time 1289.67070
Sample size   2048   iteration number   2851   MSE     0.1307   MAE     0.1727   Time 1291.45312
Sample size   2048   iteration number   2861   MSE     0.1243   MAE     0.1718   Time 1288.92207
Sample size   2048   iteration number   2871   MSE     0.1372   MAE     0.1792   Time 1289.87932
Sample size   2048   iteration number   2881   MSE     0.1201   MAE     0.1705   Time 1292.25349
Sample size   2048   iteration number   2891   MSE     0.1196   MAE     0.1698   Time 1291.11242
Sample size   2048   iteration number   2901   MSE     0.1287   MAE     0.1763   Time 1295.44806
Sample size   2048   iteration number   2911   MSE     0.1339   MAE     0.1775   Time 1285.36486
Sample size   2048   iteration number   2921   MSE     0.1282   MAE     0.1730   Time 1286.97371
Sample size   2048   iteration number   2931   MSE     0.1319   MAE     0.1755   Time 1295.37868
Sample size   2048   iteration number   2941   MSE     0.1343   MAE     0.1736   Time 1290.06648
Sample size   2048   iteration number   2951   MSE     0.1313   MAE     0.1763   Time 1283.35142
Sample size   2048   iteration number   2961   MSE     0.1409   MAE     0.1779   Time 1286.27514
Sample size   2048   iteration number   2971   MSE     0.1452   MAE     0.1825   Time 1292.08040
Sample size   2048   iteration number   2981   MSE     0.1258   MAE     0.1743   Time 1292.26779
Sample size   2048   iteration number   2991   MSE     0.1387   MAE     0.1762   Time 1297.28508
Sample size   2048   iteration number   3001   MSE     0.1352   MAE     0.1776   Time 1289.28399
Sample size   4096   iteration number      1   MSE     0.1322   MAE     0.1738   Time 2499.93515
Sample size   4096   iteration number     11   MSE     0.1373   MAE     0.1771   Time 2506.94942
Sample size   4096   iteration number     21   MSE     0.1239   MAE     0.1696   Time 2508.10742
Sample size   4096   iteration number     31   MSE     0.1282   MAE     0.1725   Time 2507.76648
Sample size   4096   iteration number     41   MSE     0.1300   MAE     0.1725   Time 2512.42828
Sample size   4096   iteration number     51   MSE     0.1374   MAE     0.1773   Time 2527.51255
Sample size   4096   iteration number     61   MSE     0.1294   MAE     0.1724   Time 2509.97853
Sample size   4096   iteration number     71   MSE     0.1106   MAE     0.1621   Time 2508.32390
Sample size   4096   iteration number     81   MSE     0.1270   MAE     0.1724   Time 2518.13435
Sample size   4096   iteration number     91   MSE     0.1387   MAE     0.1764   Time 2522.82762
Sample size   4096   iteration number    101   MSE     0.1252   MAE     0.1697   Time 2525.36320
Sample size   4096   iteration number    111   MSE     0.1206   MAE     0.1641   Time 2504.86302
Sample size   4096   iteration number    121   MSE     0.1338   MAE     0.1732   Time 2523.59581
Sample size   4096   iteration number    131   MSE     0.1185   MAE     0.1675   Time 2515.26022
Sample size   4096   iteration number    141   MSE     0.1221   MAE     0.1674   Time 2511.71851
Sample size   4096   iteration number    151   MSE     0.1219   MAE     0.1670   Time 2520.84636
Sample size   4096   iteration number    161   MSE     0.1325   MAE     0.1723   Time 2528.82719
Sample size   4096   iteration number    171   MSE     0.1250   MAE     0.1675   Time 2537.22524
Sample size   4096   iteration number    181   MSE     0.1287   MAE     0.1703   Time 2520.46084
Sample size   4096   iteration number    191   MSE     0.1226   MAE     0.1677   Time 2517.05956
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Sample size   4096   iteration number    201   MSE     0.1279   MAE     0.1699   Time 2526.28850
Sample size   4096   iteration number    211   MSE     0.1390   MAE     0.1730   Time 2524.49417
Sample size   4096   iteration number    221   MSE     0.1242   MAE     0.1709   Time 2518.63622
Sample size   4096   iteration number    231   MSE     0.1220   MAE     0.1664   Time 2512.13002
Sample size   4096   iteration number    241   MSE     0.1132   MAE     0.1617   Time 2513.32330
Sample size   4096   iteration number    251   MSE     0.1191   MAE     0.1667   Time 2507.66372
Sample size   4096   iteration number    261   MSE     0.1330   MAE     0.1727   Time 2511.83176
Sample size   4096   iteration number    271   MSE     0.1190   MAE     0.1658   Time 2508.64529
Sample size   4096   iteration number    281   MSE     0.1238   MAE     0.1645   Time 2502.89964
Sample size   4096   iteration number    291   MSE     0.1224   MAE     0.1696   Time 2517.35138
Sample size   4096   iteration number    301   MSE     0.1258   MAE     0.1717   Time 2513.32020
Sample size   4096   iteration number    311   MSE     0.1164   MAE     0.1642   Time 2551.29432
Sample size   4096   iteration number    321   MSE     0.1215   MAE     0.1684   Time 2507.29107
Sample size   4096   iteration number    331   MSE     0.1289   MAE     0.1718   Time 2512.15601
Sample size   4096   iteration number    341   MSE     0.1314   MAE     0.1712   Time 2516.30044
Sample size   4096   iteration number    351   MSE     0.1232   MAE     0.1684   Time 2516.66307
Sample size   4096   iteration number    361   MSE     0.1381   MAE     0.1764   Time 2511.96289
Sample size   4096   iteration number    371   MSE     0.1418   MAE     0.1789   Time 2502.22849
Sample size   4096   iteration number    381   MSE     0.1227   MAE     0.1680   Time 2509.41562
Sample size   4096   iteration number    391   MSE     0.1221   MAE     0.1654   Time 2546.33474
Sample size   4096   iteration number    401   MSE     0.1279   MAE     0.1695   Time 2499.09520
Sample size   4096   iteration number    411   MSE     0.1285   MAE     0.1696   Time 2523.30517
Sample size   4096   iteration number    421   MSE     0.1297   MAE     0.1717   Time 2519.82474
Sample size   4096   iteration number    431   MSE     0.1185   MAE     0.1661   Time 2507.80224
Sample size   4096   iteration number    441   MSE     0.1181   MAE     0.1643   Time 2509.49525
Sample size   4096   iteration number    451   MSE     0.1293   MAE     0.1714   Time 2513.04316
Sample size   4096   iteration number    461   MSE     0.1230   MAE     0.1684   Time 2506.21295
Sample size   4096   iteration number    471   MSE     0.1273   MAE     0.1693   Time 2507.64751
Sample size   4096   iteration number    481   MSE     0.1249   MAE     0.1690   Time 2504.34446
Sample size   4096   iteration number    491   MSE     0.1209   MAE     0.1646   Time 2516.34264
Sample size   4096   iteration number    501   MSE     0.1222   MAE     0.1672   Time 2532.83000
Sample size   4096   iteration number    511   MSE     0.1230   MAE     0.1690   Time 2508.08000
Sample size   4096   iteration number    521   MSE     0.1268   MAE     0.1747   Time 2512.79592
Sample size   4096   iteration number    531   MSE     0.1190   MAE     0.1651   Time 2518.57328
Sample size   4096   iteration number    541   MSE     0.1184   MAE     0.1662   Time 2516.07036
Sample size   4096   iteration number    551   MSE     0.1213   MAE     0.1655   Time 2512.14885
Sample size   4096   iteration number    561   MSE     0.1113   MAE     0.1605   Time 2516.15858
Sample size   4096   iteration number    571   MSE     0.1345   MAE     0.1723   Time 2508.95547
Sample size   4096   iteration number    581   MSE     0.1110   MAE     0.1625   Time 2509.14192
Sample size   4096   iteration number    591   MSE     0.1140   MAE     0.1644   Time 2508.85438
Sample size   4096   iteration number    601   MSE     0.1247   MAE     0.1708   Time 2500.07748
Sample size   4096   iteration number    611   MSE     0.1221   MAE     0.1681   Time 2510.42604
Sample size   4096   iteration number    621   MSE     0.1171   MAE     0.1629   Time 2518.85747
Sample size   4096   iteration number    631   MSE     0.1248   MAE     0.1727   Time 2529.08372
Sample size   4096   iteration number    641   MSE     0.1148   MAE     0.1639   Time 2520.91097
Sample size   4096   iteration number    651   MSE     0.1193   MAE     0.1639   Time 2512.62545
Sample size   4096   iteration number    661   MSE     0.1217   MAE     0.1670   Time 2507.78722
Sample size   4096   iteration number    671   MSE     0.1218   MAE     0.1661   Time 2511.15441
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Sample size   4096   iteration number    681   MSE     0.1194   MAE     0.1681   Time 2508.62431
Sample size   4096   iteration number    691   MSE     0.1166   MAE     0.1667   Time 2523.53668
Sample size   4096   iteration number    701   MSE     0.1177   MAE     0.1663   Time 2500.90360
Sample size   4096   iteration number    711   MSE     0.1118   MAE     0.1633   Time 2529.14929
Sample size   4096   iteration number    721   MSE     0.1146   MAE     0.1627   Time 2511.03782
Sample size   4096   iteration number    731   MSE     0.1190   MAE     0.1657   Time 2517.14968
Sample size   4096   iteration number    741   MSE     0.1072   MAE     0.1602   Time 2514.79792
Sample size   4096   iteration number    751   MSE     0.1185   MAE     0.1651   Time 2538.24520
Sample size   4096   iteration number    761   MSE     0.1237   MAE     0.1694   Time 2507.02333
Sample size   4096   iteration number    771   MSE     0.1241   MAE     0.1712   Time 2511.42478
Sample size   4096   iteration number    781   MSE     0.1208   MAE     0.1668   Time 2517.87495
Sample size   4096   iteration number    791   MSE     0.1241   MAE     0.1683   Time 2532.65857
Sample size   4096   iteration number    801   MSE     0.1094   MAE     0.1605   Time 2510.44273
Sample size   4096   iteration number    811   MSE     0.1237   MAE     0.1679   Time 2517.34495
Sample size   4096   iteration number    821   MSE     0.1155   MAE     0.1646   Time 2526.13282
Sample size   4096   iteration number    831   MSE     0.1190   MAE     0.1673   Time 2525.26521
Sample size   4096   iteration number    841   MSE     0.1234   MAE     0.1674   Time 2510.62369
Sample size   4096   iteration number    851   MSE     0.1263   MAE     0.1706   Time 2512.99977
Sample size   4096   iteration number    861   MSE     0.1227   MAE     0.1675   Time 2507.08055
Sample size   4096   iteration number    871   MSE     0.1195   MAE     0.1647   Time 2507.60340
Sample size   4096   iteration number    881   MSE     0.1126   MAE     0.1619   Time 2515.92254
Sample size   4096   iteration number    891   MSE     0.1209   MAE     0.1676   Time 2522.92156
Sample size   4096   iteration number    901   MSE     0.1203   MAE     0.1652   Time 2513.87524
Sample size   4096   iteration number    911   MSE     0.1217   MAE     0.1668   Time 2509.65309
Sample size   4096   iteration number    921   MSE     0.1340   MAE     0.1714   Time 2510.40601
Sample size   4096   iteration number    931   MSE     0.1168   MAE     0.1643   Time 2540.74382
Sample size   4096   iteration number    941   MSE     0.1176   MAE     0.1644   Time 2516.92199
Sample size   4096   iteration number    951   MSE     0.1225   MAE     0.1684   Time 2510.32376
Sample size   4096   iteration number    961   MSE     0.1226   MAE     0.1674   Time 2510.94722
Sample size   4096   iteration number    971   MSE     0.1152   MAE     0.1654   Time 2512.61234
Sample size   4096   iteration number    981   MSE     0.1221   MAE     0.1666   Time 2508.37922
Sample size   4096   iteration number    991   MSE     0.1112   MAE     0.1628   Time 2517.84491
Sample size   4096   iteration number   1001   MSE     0.1109   MAE     0.1592   Time 2522.24898
Sample size   4096   iteration number   1011   MSE     0.1137   MAE     0.1616   Time 2517.41695
Sample size   4096   iteration number   1021   MSE     0.1138   MAE     0.1640   Time 2510.91623
Sample size   4096   iteration number   1031   MSE     0.1221   MAE     0.1689   Time 2512.39466
Sample size   4096   iteration number   1041   MSE     0.1197   MAE     0.1658   Time 2515.74659
Sample size   4096   iteration number   1051   MSE     0.1286   MAE     0.1720   Time 2511.24930
Sample size   4096   iteration number   1061   MSE     0.1101   MAE     0.1595   Time 2515.50912
Sample size   4096   iteration number   1071   MSE     0.1152   MAE     0.1628   Time 2518.50605
Sample size   4096   iteration number   1081   MSE     0.1170   MAE     0.1661   Time 2539.22247
Sample size   4096   iteration number   1091   MSE     0.1066   MAE     0.1589   Time 2520.81275
Sample size   4096   iteration number   1101   MSE     0.1008   MAE     0.1577   Time 2511.21544
Sample size   4096   iteration number   1111   MSE     0.1238   MAE     0.1669   Time 2523.83375
Sample size   4096   iteration number   1121   MSE     0.1191   MAE     0.1657   Time 2530.87329
Sample size   4096   iteration number   1131   MSE     0.1205   MAE     0.1681   Time 2516.91579
Sample size   4096   iteration number   1141   MSE     0.1160   MAE     0.1649   Time 2518.32604
Sample size   4096   iteration number   1151   MSE     0.1164   MAE     0.1643   Time 2509.66167
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Sample size   4096   iteration number   1161   MSE     0.1150   MAE     0.1625   Time 2515.53797
Sample size   4096   iteration number   1171   MSE     0.1152   MAE     0.1631   Time 2516.87097
Sample size   4096   iteration number   1181   MSE     0.1205   MAE     0.1653   Time 2523.83256
Sample size   4096   iteration number   1191   MSE     0.1157   MAE     0.1618   Time 2516.51191
Sample size   4096   iteration number   1201   MSE     0.1122   MAE     0.1627   Time 2518.46575
Sample size   4096   iteration number   1211   MSE     0.1151   MAE     0.1639   Time 2517.52901
Sample size   4096   iteration number   1221   MSE     0.1083   MAE     0.1603   Time 2514.63961
Sample size   4096   iteration number   1231   MSE     0.1268   MAE     0.1675   Time 2732.66935
Sample size   4096   iteration number   1241   MSE     0.1178   MAE     0.1641   Time 2781.50224
Sample size   4096   iteration number   1251   MSE     0.1103   MAE     0.1619   Time 2603.56307
Sample size   4096   iteration number   1261   MSE     0.1220   MAE     0.1680   Time 2638.96203
Sample size   4096   iteration number   1271   MSE     0.1222   MAE     0.1653   Time 2587.08405
Sample size   4096   iteration number   1281   MSE     0.1171   MAE     0.1641   Time 2717.73505
Sample size   4096   iteration number   1291   MSE     0.1284   MAE     0.1687   Time 2569.11087
Sample size   4096   iteration number   1301   MSE     0.1165   MAE     0.1638   Time 2573.12035
Sample size   4096   iteration number   1311   MSE     0.1151   MAE     0.1627   Time 2571.10428
Sample size   4096   iteration number   1321   MSE     0.1233   MAE     0.1650   Time 2730.16381
Sample size   4096   iteration number   1331   MSE     0.1101   MAE     0.1625   Time 2569.13042
Sample size   4096   iteration number   1341   MSE     0.1189   MAE     0.1678   Time 2567.13843
Sample size   4096   iteration number   1351   MSE     0.1090   MAE     0.1626   Time 2567.13485
Sample size   4096   iteration number   1361   MSE     0.1078   MAE     0.1594   Time 2565.39821
Sample size   4096   iteration number   1371   MSE     0.1288   MAE     0.1702   Time 2563.14683
Sample size   4096   iteration number   1381   MSE     0.1210   MAE     0.1693   Time 2573.11987
Sample size   4096   iteration number   1391   MSE     0.1222   MAE     0.1707   Time 2563.14635
Sample size   4096   iteration number   1401   MSE     0.1271   MAE     0.1729   Time 2565.14167
Sample size   4096   iteration number   1411   MSE     0.1190   MAE     0.1655   Time 2566.13850
Sample size   4096   iteration number   1421   MSE     0.1107   MAE     0.1624   Time 2570.09482
Sample size   4096   iteration number   1431   MSE     0.1124   MAE     0.1619   Time 2570.23382
Sample size   4096   iteration number   1441   MSE     0.1183   MAE     0.1648   Time 2709.73253
Sample size   4096   iteration number   1451   MSE     0.1186   MAE     0.1648   Time 2780.05290
Sample size   4096   iteration number   1461   MSE     0.1169   MAE     0.1651   Time 2641.90101
Sample size   4096   iteration number   1471   MSE     0.1118   MAE     0.1637   Time 2705.74045
Sample size   4096   iteration number   1481   MSE     0.1077   MAE     0.1583   Time 2692.85178
Sample size   4096   iteration number   1491   MSE     0.1197   MAE     0.1657   Time 2571.12360
Sample size   4096   iteration number   1501   MSE     0.1191   MAE     0.1655   Time 2572.91102
Sample size   4096   iteration number   1511   MSE     0.1183   MAE     0.1653   Time 2577.10957
Sample size   4096   iteration number   1521   MSE     0.1187   MAE     0.1654   Time 2632.96032
Sample size   4096   iteration number   1531   MSE     0.1090   MAE     0.1590   Time 2571.12526
Sample size   4096   iteration number   1541   MSE     0.1237   MAE     0.1686   Time 2627.97355
Sample size   4096   iteration number   1551   MSE     0.1135   MAE     0.1621   Time 2575.15955
Sample size   4096   iteration number   1561   MSE     0.1197   MAE     0.1627   Time 2576.11346
Sample size   4096   iteration number   1571   MSE     0.1175   MAE     0.1628   Time 2576.09057
Sample size   4096   iteration number   1581   MSE     0.1158   MAE     0.1653   Time 2634.95516
Sample size   4096   iteration number   1591   MSE     0.1176   MAE     0.1650   Time 2627.97308
Sample size   4096   iteration number   1601   MSE     0.1121   MAE     0.1595   Time 2563.18140
Sample size   4096   iteration number   1611   MSE     0.1134   MAE     0.1602   Time 2560.12368
Sample size   4096   iteration number   1621   MSE     0.1090   MAE     0.1645   Time 2638.94343
Sample size   4096   iteration number   1631   MSE     0.1147   MAE     0.1607   Time 2566.13874
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Sample size   4096   iteration number   1641   MSE     0.1142   MAE     0.1613   Time 2640.93852
Sample size   4096   iteration number   1651   MSE     0.1216   MAE     0.1652   Time 2647.91965
Sample size   4096   iteration number   1661   MSE     0.1231   MAE     0.1684   Time 2565.14000
Sample size   4096   iteration number   1671   MSE     0.1150   MAE     0.1630   Time 2570.10436
Sample size   4096   iteration number   1681   MSE     0.1140   MAE     0.1641   Time 2575.11258
Sample size   4096   iteration number   1691   MSE     0.1116   MAE     0.1600   Time 2593.06645
Sample size   4096   iteration number   1701   MSE     0.1064   MAE     0.1591   Time 2585.08825
Sample size   4096   iteration number   1711   MSE     0.1236   MAE     0.1660   Time 2559.12256
Sample size   4096   iteration number   1721   MSE     0.1131   MAE     0.1641   Time 2575.11472
Sample size   4096   iteration number   1731   MSE     0.1216   MAE     0.1676   Time 2575.09350
Sample size   4096   iteration number   1741   MSE     0.1225   MAE     0.1678   Time 2567.13748
Sample size   4096   iteration number   1751   MSE     0.1252   MAE     0.1678   Time 2570.18184
Sample size   4096   iteration number   1761   MSE     0.1124   MAE     0.1615   Time 2584.09476
Sample size   4096   iteration number   1771   MSE     0.1204   MAE     0.1644   Time 2578.12619
Sample size   4096   iteration number   1781   MSE     0.1225   MAE     0.1690   Time 2573.12178
Sample size   4096   iteration number   1791   MSE     0.1156   MAE     0.1634   Time 2574.13768
Sample size   4096   iteration number   1801   MSE     0.1230   MAE     0.1680   Time 2573.09913
Sample size   4096   iteration number   1811   MSE     0.1125   MAE     0.1626   Time 2569.12946
Sample size   4096   iteration number   1821   MSE     0.1070   MAE     0.1602   Time 2578.10401
Sample size   4096   iteration number   1831   MSE     0.1128   MAE     0.1612   Time 2567.13652
Sample size   4096   iteration number   1841   MSE     0.1091   MAE     0.1620   Time 2565.14215
Sample size   4096   iteration number   1851   MSE     0.1215   MAE     0.1696   Time 2580.10172
Sample size   4096   iteration number   1861   MSE     0.1146   MAE     0.1644   Time 2588.08016
Sample size   4096   iteration number   1871   MSE     0.1224   MAE     0.1679   Time 2569.12970
Sample size   4096   iteration number   1881   MSE     0.1143   MAE     0.1636   Time 2576.11465
Sample size   4096   iteration number   1891   MSE     0.1257   MAE     0.1683   Time 2583.09125
Sample size   4096   iteration number   1901   MSE     0.1101   MAE     0.1612   Time 2564.14151
Sample size   4096   iteration number   1911   MSE     0.1285   MAE     0.1715   Time 2575.08277
Sample size   4096   iteration number   1921   MSE     0.1146   MAE     0.1627   Time 2573.08292
Sample size   4096   iteration number   1931   MSE     0.1157   MAE     0.1618   Time 2564.14318
Sample size   4096   iteration number   1941   MSE     0.1084   MAE     0.1596   Time 2564.14222
Sample size   4096   iteration number   1951   MSE     0.1189   MAE     0.1646   Time 2579.08630
Sample size   4096   iteration number   1961   MSE     0.1079   MAE     0.1624   Time 2577.08931
Sample size   4096   iteration number   1971   MSE     0.1207   MAE     0.1676   Time 2561.15603
Sample size   4096   iteration number   1981   MSE     0.1138   MAE     0.1610   Time 2585.08801
Sample size   4096   iteration number   1991   MSE     0.1161   MAE     0.1634   Time 2577.13556
Sample size   4096   iteration number   2001   MSE     0.1242   MAE     0.1674   Time 2588.08541
Sample size   4096   iteration number   2011   MSE     0.1168   MAE     0.1672   Time 2584.11002
Sample size   4096   iteration number   2021   MSE     0.1115   MAE     0.1625   Time 2574.13554
Sample size   4096   iteration number   2031   MSE     0.1179   MAE     0.1638   Time 2574.11694
Sample size   4096   iteration number   2041   MSE     0.1132   MAE     0.1641   Time 2573.06718
Sample size   4096   iteration number   2051   MSE     0.1212   MAE     0.1665   Time 2572.12257
Sample size   4096   iteration number   2061   MSE     0.1182   MAE     0.1650   Time 2569.13113
Sample size   4096   iteration number   2071   MSE     0.1082   MAE     0.1579   Time 2574.11766
Sample size   4096   iteration number   2081   MSE     0.1126   MAE     0.1598   Time 2575.11496
Sample size   4096   iteration number   2091   MSE     0.1223   MAE     0.1668   Time 2566.10059
Sample size   4096   iteration number   2101   MSE     0.1127   MAE     0.1630   Time 2589.07771
Sample size   4096   iteration number   2111   MSE     0.1144   MAE     0.1608   Time 2586.08198
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Sample size   4096   iteration number   2121   MSE     0.1166   MAE     0.1637   Time 2569.15092
Sample size   4096   iteration number   2131   MSE     0.1265   MAE     0.1710   Time 2562.15214
Sample size   4096   iteration number   2141   MSE     0.1099   MAE     0.1626   Time 2609.02929
Sample size   4096   iteration number   2151   MSE     0.1122   MAE     0.1625   Time 2590.07310
Sample size   4096   iteration number   2161   MSE     0.1111   MAE     0.1637   Time 2585.10685
Sample size   4096   iteration number   2171   MSE     0.1186   MAE     0.1634   Time 2565.13500
Sample size   4096   iteration number   2181   MSE     0.0971   MAE     0.1542   Time 2560.13536
Sample size   4096   iteration number   2191   MSE     0.1179   MAE     0.1641   Time 2571.10452
Sample size   4096   iteration number   2201   MSE     0.1172   MAE     0.1655   Time 2575.09255
Sample size   4096   iteration number   2211   MSE     0.1186   MAE     0.1618   Time 2591.07112
Sample size   4096   iteration number   2221   MSE     0.1114   MAE     0.1600   Time 2576.12872
Sample size   4096   iteration number   2231   MSE     0.1242   MAE     0.1674   Time 2582.09896
Sample size   4096   iteration number   2241   MSE     0.1141   MAE     0.1614   Time 2580.10625
Sample size   4096   iteration number   2251   MSE     0.1146   MAE     0.1598   Time 2569.13042
Sample size   4096   iteration number   2261   MSE     0.1238   MAE     0.1669   Time 2585.10685
Sample size   4096   iteration number   2271   MSE     0.1122   MAE     0.1630   Time 2571.14577
Sample size   4096   iteration number   2281   MSE     0.1030   MAE     0.1557   Time 2582.09323
Sample size   4096   iteration number   2291   MSE     0.1208   MAE     0.1664   Time 2578.10497
Sample size   4096   iteration number   2301   MSE     0.1191   MAE     0.1651   Time 2570.12772
Sample size   4096   iteration number   2311   MSE     0.1067   MAE     0.1606   Time 2568.13335
Sample size   4096   iteration number   2321   MSE     0.1069   MAE     0.1598   Time 2564.17775
Sample size   4096   iteration number   2331   MSE     0.1121   MAE     0.1628   Time 2567.18850
Sample size   4096   iteration number   2341   MSE     0.1153   MAE     0.1637   Time 2569.13089
Sample size   4096   iteration number   2351   MSE     0.1100   MAE     0.1615   Time 2594.06280
Sample size   4096   iteration number   2361   MSE     0.1037   MAE     0.1566   Time 2575.11448
Sample size   4096   iteration number   2371   MSE     0.1147   MAE     0.1644   Time 2618.94106
Sample size   4096   iteration number   2381   MSE     0.1152   MAE     0.1641   Time 2592.99063
Sample size   4096   iteration number   2391   MSE     0.1192   MAE     0.1671   Time 2578.10378
Sample size   4096   iteration number   2401   MSE     0.1120   MAE     0.1623   Time 2563.14539
Sample size   4096   iteration number   2411   MSE     0.1070   MAE     0.1597   Time 2567.11936
Sample size   4096   iteration number   2421   MSE     0.1110   MAE     0.1599   Time 2595.90745
Sample size   4096   iteration number   2431   MSE     0.1126   MAE     0.1613   Time 2567.14010
Sample size   4096   iteration number   2441   MSE     0.1015   MAE     0.1558   Time 2583.08982
Sample size   4096   iteration number   2451   MSE     0.1040   MAE     0.1578   Time 2564.36967
Sample size   4096   iteration number   2461   MSE     0.1128   MAE     0.1618   Time 2574.11742
Sample size   4096   iteration number   2471   MSE     0.1062   MAE     0.1581   Time 2576.11250
Sample size   4096   iteration number   2481   MSE     0.1126   MAE     0.1646   Time 2573.11749
Sample size   4096   iteration number   2491   MSE     0.1059   MAE     0.1594   Time 2605.07702
Sample size   4096   iteration number   2501   MSE     0.1115   MAE     0.1612   Time 2618.99614
Sample size   4096   iteration number   2511   MSE     0.1217   MAE     0.1664   Time 2603.03998
Sample size   4096   iteration number   2521   MSE     0.1071   MAE     0.1591   Time 2574.06544
Sample size   4096   iteration number   2531   MSE     0.1191   MAE     0.1642   Time 2565.14072
Sample size   4096   iteration number   2541   MSE     0.1087   MAE     0.1598   Time 2564.12577
Sample size   4096   iteration number   2551   MSE     0.1235   MAE     0.1679   Time 2580.10888
Sample size   4096   iteration number   2561   MSE     0.1069   MAE     0.1605   Time 2577.11005
Sample size   4096   iteration number   2571   MSE     0.1211   MAE     0.1654   Time 2571.12288
Sample size   4096   iteration number   2581   MSE     0.1210   MAE     0.1639   Time 2583.09078
Sample size   4096   iteration number   2591   MSE     0.1150   MAE     0.1617   Time 2580.52206
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Sample size   4096   iteration number   2601   MSE     0.1054   MAE     0.1595   Time 2574.13530
Sample size   4096   iteration number   2611   MSE     0.1028   MAE     0.1565   Time 2579.12325
Sample size   4096   iteration number   2621   MSE     0.1134   MAE     0.1615   Time 2599.05481
Sample size   4096   iteration number   2631   MSE     0.1187   MAE     0.1633   Time 2557.16824
Sample size   4096   iteration number   2641   MSE     0.1086   MAE     0.1627   Time 2577.10862
Sample size   4096   iteration number   2651   MSE     0.1129   MAE     0.1590   Time 2576.11012
Sample size   4096   iteration number   2661   MSE     0.1172   MAE     0.1626   Time 2563.44795
Sample size   4096   iteration number   2671   MSE     0.1160   MAE     0.1650   Time 2564.14485
Sample size   4096   iteration number   2681   MSE     0.1198   MAE     0.1663   Time 2567.11769
Sample size   4096   iteration number   2691   MSE     0.1132   MAE     0.1634   Time 2567.13295
Sample size   4096   iteration number   2701   MSE     0.1069   MAE     0.1597   Time 2635.95175
Sample size   4096   iteration number   2711   MSE     0.1151   MAE     0.1637   Time 2557.16276
Sample size   4096   iteration number   2721   MSE     0.1135   MAE     0.1629   Time 2617.99955
Sample size   4096   iteration number   2731   MSE     0.1076   MAE     0.1606   Time 2571.15769
Sample size   4096   iteration number   2741   MSE     0.1141   MAE     0.1627   Time 2637.94636
Sample size   4096   iteration number   2751   MSE     0.0959   MAE     0.1549   Time 2641.93511
Sample size   4096   iteration number   2761   MSE     0.1089   MAE     0.1580   Time 2582.09586
Sample size   4096   iteration number   2771   MSE     0.1132   MAE     0.1622   Time 2570.12820
Sample size   4096   iteration number   2781   MSE     0.1165   MAE     0.1631   Time 2577.10957
Sample size   4096   iteration number   2791   MSE     0.1184   MAE     0.1634   Time 2573.12011
Sample size   4096   iteration number   2801   MSE     0.1130   MAE     0.1624   Time 2567.13986
Sample size   4096   iteration number   2811   MSE     0.1101   MAE     0.1616   Time 2571.12526
Sample size   4096   iteration number   2821   MSE     0.1101   MAE     0.1626   Time 2572.12090
Sample size   4096   iteration number   2831   MSE     0.1057   MAE     0.1593   Time 2562.16979
Sample size   4096   iteration number   2841   MSE     0.1024   MAE     0.1595   Time 2575.11615
Sample size   4096   iteration number   2851   MSE     0.1100   MAE     0.1623   Time 2574.11503
Sample size   4096   iteration number   2861   MSE     0.1135   MAE     0.1623   Time 2574.09763
Sample size   4096   iteration number   2871   MSE     0.1033   MAE     0.1593   Time 2580.11937
Sample size   4096   iteration number   2881   MSE     0.1191   MAE     0.1660   Time 2573.12250
Sample size   4096   iteration number   2891   MSE     0.1196   MAE     0.1649   Time 2579.10633
Sample size   4096   iteration number   2901   MSE     0.1177   MAE     0.1662   Time 2574.11742
Sample size   4096   iteration number   2911   MSE     0.1165   MAE     0.1606   Time 2575.13546
Sample size   4096   iteration number   2921   MSE     0.1152   MAE     0.1624   Time 2509.34100
Sample size   4096   iteration number   2931   MSE     0.1113   MAE     0.1599   Time 2521.84939
Sample size   4096   iteration number   2941   MSE     0.1130   MAE     0.1626   Time 2542.11282
Sample size   4096   iteration number   2951   MSE     0.1138   MAE     0.1631   Time 2509.92107
Sample size   4096   iteration number   2961   MSE     0.1069   MAE     0.1620   Time 2514.18709
Sample size   4096   iteration number   2971   MSE     0.1145   MAE     0.1620   Time 2517.23408
Sample size   4096   iteration number   2981   MSE     0.1129   MAE     0.1635   Time 2531.92782
Sample size   4096   iteration number   2991   MSE     0.0951   MAE     0.1534   Time 2525.87366
Sample size   4096   iteration number   3001   MSE     0.1124   MAE     0.1626   Time 2522.74870
Sample size   4096   iteration number   3011   MSE     0.1092   MAE     0.1617   Time 2536.52143
Sample size   4096   iteration number   3021   MSE     0.1161   MAE     0.1651   Time 2517.87567
Sample size   4096   iteration number   3031   MSE     0.1125   MAE     0.1618   Time 2507.91931
Sample size   4096   iteration number   3041   MSE     0.1100   MAE     0.1590   Time 2519.36864
Sample size   4096   iteration number   3051   MSE     0.1143   MAE     0.1633   Time 2517.80390
Sample size   4096   iteration number   3061   MSE     0.1105   MAE     0.1622   Time 2517.89784
Sample size   4096   iteration number   3071   MSE     0.1055   MAE     0.1600   Time 2511.94691
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Sample size   4096   iteration number   3081   MSE     0.1054   MAE     0.1592   Time 2525.90918
Sample size   4096   iteration number   3091   MSE     0.1085   MAE     0.1583   Time 2522.97806
Sample size   4096   iteration number   3101   MSE     0.1182   MAE     0.1674   Time 2503.07583
Sample size   4096   iteration number   3111   MSE     0.1186   MAE     0.1659   Time 2508.49747
Sample size   4096   iteration number   3121   MSE     0.1227   MAE     0.1641   Time 2520.21551
Sample size   4096   iteration number   3131   MSE     0.1186   MAE     0.1662   Time 2512.00866
Sample size   4096   iteration number   3141   MSE     0.1118   MAE     0.1626   Time 2507.87448
Sample size   4096   iteration number   3151   MSE     0.1057   MAE     0.1578   Time 2504.42075
Sample size   4096   iteration number   3161   MSE     0.1083   MAE     0.1600   Time 2526.76725
Sample size   4096   iteration number   3171   MSE     0.1059   MAE     0.1592   Time 2527.29535
Sample size   4096   iteration number   3181   MSE     0.1077   MAE     0.1613   Time 2518.82648
Sample size   4096   iteration number   3191   MSE     0.1046   MAE     0.1593   Time 2519.24562
Sample size   4096   iteration number   3201   MSE     0.1012   MAE     0.1555   Time 2511.20686
Sample size   4096   iteration number   3211   MSE     0.1233   MAE     0.1657   Time 2500.19502
Sample size   4096   iteration number   3221   MSE     0.1049   MAE     0.1584   Time 2515.28644
Sample size   4096   iteration number   3231   MSE     0.1101   MAE     0.1599   Time 2509.60373
Sample size   4096   iteration number   3241   MSE     0.1178   MAE     0.1638   Time 2519.67263
Sample size   4096   iteration number   3251   MSE     0.1207   MAE     0.1652   Time 2506.83808
Sample size   4096   iteration number   3261   MSE     0.1162   MAE     0.1650   Time 2505.22470
Sample size   4096   iteration number   3271   MSE     0.1035   MAE     0.1592   Time 2517.23623
Sample size   4096   iteration number   3281   MSE     0.1213   MAE     0.1700   Time 2515.23780
Sample size   4096   iteration number   3291   MSE     0.1075   MAE     0.1579   Time 2521.30603
Sample size   4096   iteration number   3301   MSE     0.1014   MAE     0.1561   Time 2512.76373
Sample size   4096   iteration number   3311   MSE     0.1087   MAE     0.1592   Time 2507.84277
Sample size   4096   iteration number   3321   MSE     0.1022   MAE     0.1571   Time 2515.04063
Sample size   4096   iteration number   3331   MSE     0.1092   MAE     0.1606   Time 2520.88832
Sample size   4096   iteration number   3341   MSE     0.1139   MAE     0.1626   Time 2508.87227
Sample size   4096   iteration number   3351   MSE     0.1015   MAE     0.1550   Time 2520.95484
Sample size   4096   iteration number   3361   MSE     0.1077   MAE     0.1583   Time 2552.02698
Sample size   4096   iteration number   3371   MSE     0.1090   MAE     0.1586   Time 2517.22669
Sample size   4096   iteration number   3381   MSE     0.1182   MAE     0.1642   Time 2509.82022
Sample size   4096   iteration number   3391   MSE     0.1150   MAE     0.1622   Time 2515.21110
Sample size   4096   iteration number   3401   MSE     0.1137   MAE     0.1633   Time 2505.72657
Sample size   4096   iteration number   3411   MSE     0.1078   MAE     0.1581   Time 2514.98365
Sample size   4096   iteration number   3421   MSE     0.1175   MAE     0.1652   Time 2520.06650
Sample size   4096   iteration number   3431   MSE     0.1093   MAE     0.1594   Time 2515.01679
Sample size   4096   iteration number   3441   MSE     0.1079   MAE     0.1598   Time 2581.07686
Sample size   4096   iteration number   3451   MSE     0.1017   MAE     0.1561   Time 2506.64067
Sample size   4096   iteration number   3461   MSE     0.1116   MAE     0.1597   Time 2502.93135
Sample size   4096   iteration number   3471   MSE     0.1264   MAE     0.1677   Time 2522.27592
Sample size   4096   iteration number   3481   MSE     0.1120   MAE     0.1616   Time 2509.46021
Sample size   4096   iteration number   3491   MSE     0.1074   MAE     0.1609   Time 2524.29485
Sample size   4096   iteration number   3501   MSE     0.1098   MAE     0.1591   Time 2507.64775
Sample size   4096   iteration number   3511   MSE     0.0989   MAE     0.1542   Time 2523.52380
Sample size   4096   iteration number   3521   MSE     0.1051   MAE     0.1577   Time 2507.06386
Sample size   4096   iteration number   3531   MSE     0.1088   MAE     0.1614   Time 2506.78587
Sample size   4096   iteration number   3541   MSE     0.1149   MAE     0.1640   Time 2518.62812
Sample size   4096   iteration number   3551   MSE     0.1077   MAE     0.1588   Time 2532.62424
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Sample size   4096   iteration number   3561   MSE     0.1203   MAE     0.1649   Time 2513.43846
Sample size   4096   iteration number   3571   MSE     0.1077   MAE     0.1617   Time 2521.30866
Sample size   4096   iteration number   3581   MSE     0.1183   MAE     0.1639   Time 2521.14009
Sample size   4096   iteration number   3591   MSE     0.1111   MAE     0.1605   Time 2514.96291
Sample size   4096   iteration number   3601   MSE     0.1090   MAE     0.1626   Time 2515.87867
Sample size   4096   iteration number   3611   MSE     0.1133   MAE     0.1633   Time 2513.82541
Sample size   4096   iteration number   3621   MSE     0.1057   MAE     0.1597   Time 2514.09530
Sample size   4096   iteration number   3631   MSE     0.1114   MAE     0.1625   Time 2520.07889
Sample size   4096   iteration number   3641   MSE     0.0996   MAE     0.1558   Time 2512.44354
Sample size   4096   iteration number   3651   MSE     0.1054   MAE     0.1574   Time 2717.09919
Sample size   4096   iteration number   3661   MSE     0.1041   MAE     0.1596   Time 2786.58127
Sample size   4096   iteration number   3671   MSE     0.1100   MAE     0.1617   Time 2603.04021
Sample size   4096   iteration number   3681   MSE     0.1157   MAE     0.1645   Time 2571.12550
Sample size   4096   iteration number   3691   MSE     0.1053   MAE     0.1586   Time 2580.44624
Sample size   4096   iteration number   3701   MSE     0.1086   MAE     0.1616   Time 2574.11742
Sample size   4096   iteration number   3711   MSE     0.1031   MAE     0.1582   Time 2570.12772
Sample size   4096   iteration number   3721   MSE     0.1094   MAE     0.1582   Time 2576.11203
Sample size   4096   iteration number   3731   MSE     0.1084   MAE     0.1592   Time 2672.28746
Sample size   4096   iteration number   3741   MSE     0.1097   MAE     0.1621   Time 2579.15711
Sample size   4096   iteration number   3751   MSE     0.1049   MAE     0.1598   Time 2573.17376
Sample size   4096   iteration number   3761   MSE     0.1192   MAE     0.1645   Time 2574.11718
Sample size   4096   iteration number   3771   MSE     0.1224   MAE     0.1646   Time 2581.86292
Sample size   4096   iteration number   3781   MSE     0.1143   MAE     0.1631   Time 2573.10009
Sample size   4096   iteration number   3791   MSE     0.1101   MAE     0.1598   Time 2563.12680
Sample size   4096   iteration number   3801   MSE     0.1193   MAE     0.1631   Time 2565.14191
Sample size   4096   iteration number   3811   MSE     0.1119   MAE     0.1624   Time 2580.10149
Sample size   4096   iteration number   3821   MSE     0.1033   MAE     0.1543   Time 2579.10394
Sample size   4096   iteration number   3831   MSE     0.1130   MAE     0.1622   Time 2584.12361
Sample size   4096   iteration number   3841   MSE     0.1092   MAE     0.1587   Time 2568.10236
Sample size   4096   iteration number   3851   MSE     0.1005   MAE     0.1558   Time 2574.13435
Sample size   4096   iteration number   3861   MSE     0.1046   MAE     0.1580   Time 2567.10553
Sample size   4096   iteration number   3871   MSE     0.1137   MAE     0.1601   Time 2585.86430
Sample size   4096   iteration number   3881   MSE     0.1085   MAE     0.1603   Time 2596.05884
Sample size   4096   iteration number   3891   MSE     0.1074   MAE     0.1589   Time 2584.09214
Sample size   4096   iteration number   3901   MSE     0.1076   MAE     0.1571   Time 2572.12185
Sample size   4096   iteration number   3911   MSE     0.1056   MAE     0.1599   Time 2574.13530
Sample size   4096   iteration number   3921   MSE     0.1112   MAE     0.1614   Time 2583.09316
Sample size   4096   iteration number   3931   MSE     0.1027   MAE     0.1579   Time 2569.13065
Sample size   4096   iteration number   3941   MSE     0.1112   MAE     0.1586   Time 2572.12495
Sample size   4096   iteration number   3951   MSE     0.1126   MAE     0.1623   Time 2571.12479
Sample size   4096   iteration number   3961   MSE     0.1139   MAE     0.1601   Time 2564.20445
Sample size   4096   iteration number   3971   MSE     0.1082   MAE     0.1596   Time 2601.06849
Sample size   4096   iteration number   3981   MSE     0.1117   MAE     0.1594   Time 2575.09684
Sample size   4096   iteration number   3991   MSE     0.1078   MAE     0.1612   Time 2580.08313
Sample size   4096   iteration number   4001   MSE     0.1084   MAE     0.1577   Time 2568.31979
```

1.6 6. PLOT LEARNING PERFORMANCE

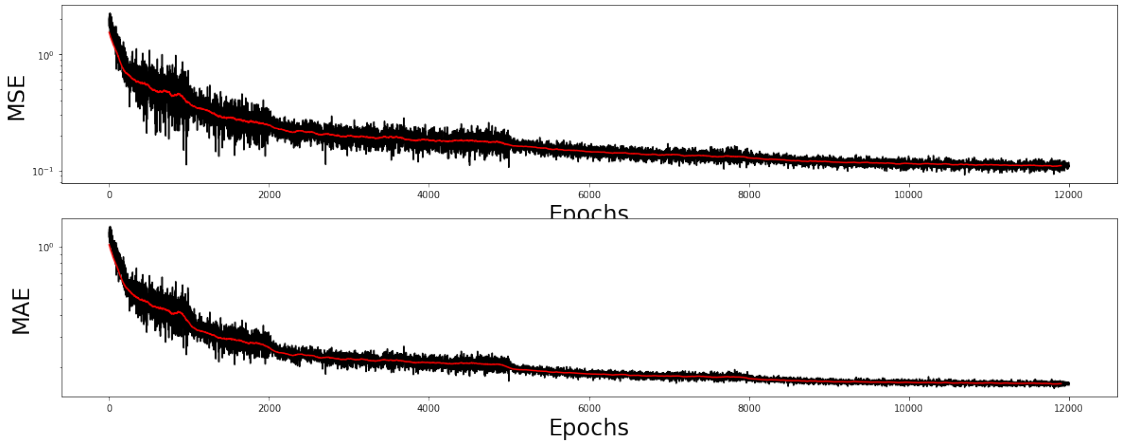
The learning performance is plotted. The MSE, MAE, sample size, iteration number and iteration time are plotted against the number of timesteps.

Comment: 1. The parameter number_of_timesteps_for_average determines the length of the average. It must be a positive integer number.

In [8]:
```
### Plot learning performance

number_of_timesteps_for_average = 100

DeepCalib.plot_learning_performance(training_history, number_of_timesteps_for_average)
```



1.7 7. TEST DEEP LEARNING NETWORK ON NEW SIMULATED TRAJECTORIES

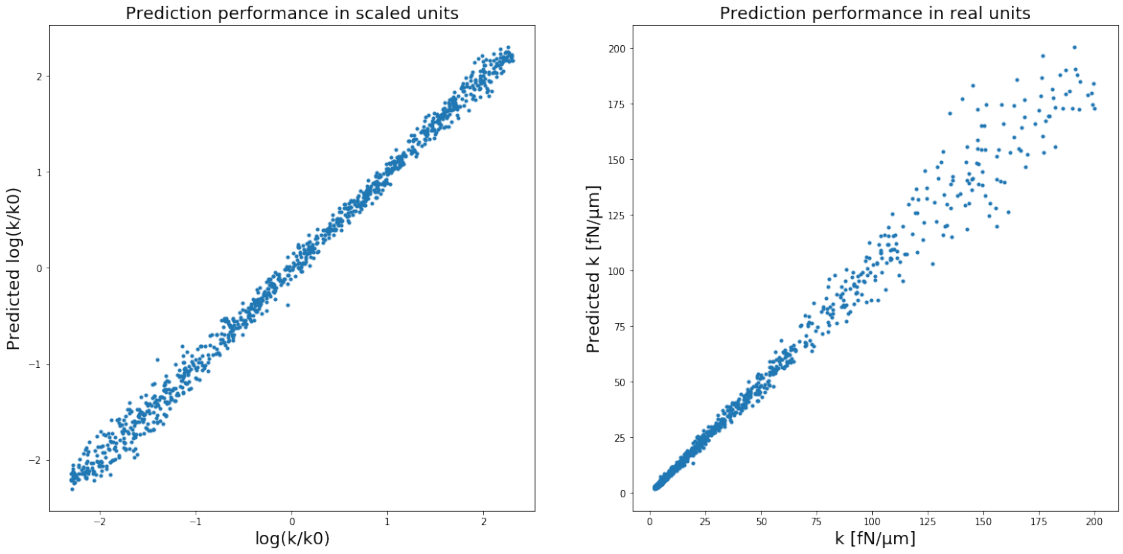
The deep learning network is tested on new simulated trajectories (parameters are defined in Section **??**). The predicted values of the targets are plotted as function of their ground-truth values both in scaled and physical units.

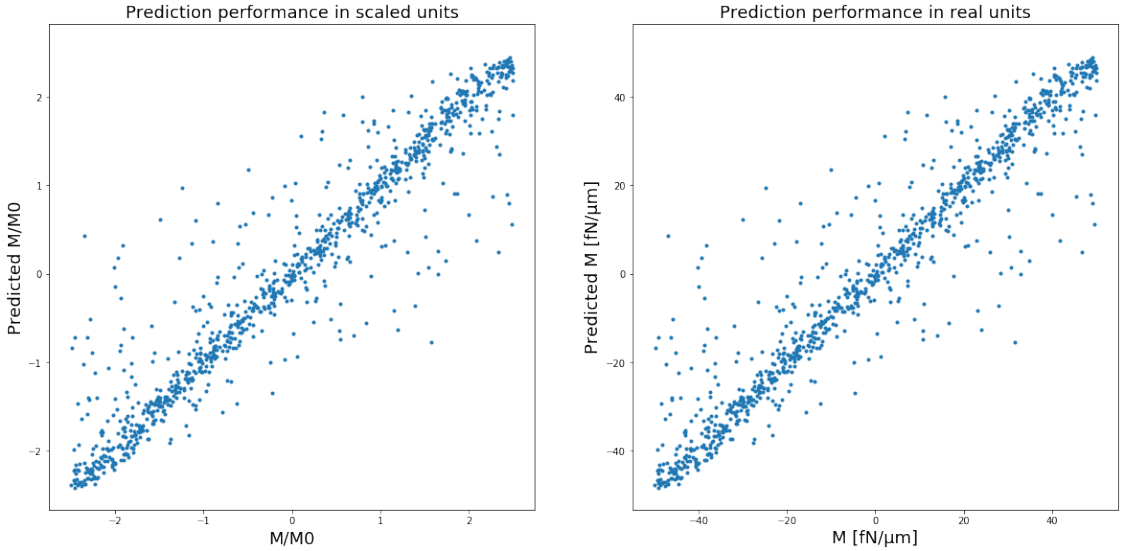
Comments: 1. The parameter number_of_predictions_to_show determines the number of predictions that are shown.

In [13]:
```
### Test the predictions of the deep learning network on some generated trajectories

number_of_predictions_to_show = 1000

%matplotlib inline
DeepCalib.plot_test_performance(simulate_trajectory, network, rescale_targets, number_o
```





1.8 8. SAVE DEEP LEARNING NETWORK

Comments: 1. The parameter save_file_name is the name of the file where the deep learnign network is saved. 2. By default, the network is saved in the same folder where DeepCalib is running.

```
In [10]: save_file_name = 'Network_Example_3a.h5'
         network.save(save_file_name)
```